REPORT RESUMES

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A METHODOLOGY FOR DETERMINING FUTURE PHYSICAL FACILITIES REQUIREMENTS FOR INSTITUTIONS OF HIGHER EDUCATION.

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A COMPUTERIZED METHODOLOGY FOR DETERMINING THE PHYSICAL FACILITIES REQUIREMENTS OF A LARGE UNIVERSITY WAS DEVELOPED. THE RESEARCH INCLUDED THE DEVELOPMENT, IMPLEMENTATION, AND TESTING OF SYSTEMS FOR (1) CLASSIFYING SPACE, (2) MAINTAINING A PERPETUAL SPACE INVENTORY, (3) CONDUCTING ROOM UTILIZATION STUDIES, (4) PROJECTING STUDENTS BY A SET OF DEFINED MEASURES, (5) PROJECTING STAFF AND THEIR SPACE NEEDS, AND (6) INTEGRATING THE STRUCTURED INPUT DATA, AND (7) PROJECTING FUTURE PHYSICAL FACILITIES REQUIREMENTS. EACH SYSTEM WAS IMPLEMENTED AND TESTED BY DIRECT APPLICATION TO THE INSTITUTIONAL NEEDS OF THE UNIVERSITY OF WISCONSIN. IN THE REPORT OF THE METHODOLOGY, THE DIMENSIONS INHERENT IN THE DEVELOPMENT OF A SPACE PROGRAM, THE REQUIRED DATA SYSTEMS, AND THE ORGANIZATION OF THE SYSTEMS FOR PROJECTING SPACE REQUIREMENTS WERE DISCUSSED. CONTAINED IN THE APPENDIXES WERE CODE LISTS, DATA REPORTS, DETAILED GUIDES, FLOWCHART REPRESENTATIONS OF THE SYSTEMS, AND SUPPORTIVE INFORMATION PERTINENT TO SPACE MANAGEMENT AND PLANNING. (GD)

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December 1966

U.S. DEPARTMENT OF

HEALTH, EDUCATION AND WELFARE

Office of Education
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John V. Yurkovich

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The University of Wisconsin

Madison, Wisconsin

INTRODUCTION

In recent years institutions of higher education have undergone a rapid physical growth. This has been occasioned by several factors: enrollments have risen sharply; the array of educational services demanded has broadened considerably; research activity has been stimulated to unprecedented levels; and the public service function has been expanded to a wide number of fields. This growth and expansion of institutional activities has placed a heavy stress on the physical facilities and has emphasized the need for efficient management of existing space and more systematic planning of new facilities.

Statement of the Problem

Large and small institutions, both public and private, are confronted with the problems of measuring current student capacity, estimating future physical facilities needs, establishing priorities for new construction, and delineating present and future problems with regard to physical space. Relatively general methods have existed to guide decision making in this management area.

Effective management of an institution requires a continuous evaluation of existing facilities and the constant realignment of their use to properly accommodate changes in educational objectives and methods. Techniques are needed whereby an administrator can rapidly assess the level of efficiency of his institution as a basis for implementing needed changes. Similarly, techniques are needed for expediently estimating needs when factors such as enrollment trends, educational objectives, and teaching methods change.

Burgeoning student enrollments, expanding curricula, and changing policies are forcing colleges and universities to review their operating methods on a continuing basis. Such constant review is necessary in order that enrollments can be increased through more efficient utilization of existing spaces and to insure that expansion funds will provide the most useful facilities. It is also essential to effective planning of new colleges and universities which may be required to meet present and future needs of entire geographic areas.

The task of rearranging or providing new space to meet program needs is generally delegated to specialists in the area of physical facilities. Many institutions, however, have inadequate organization and personnel in this management area to evaluate

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The secretarial assistant for providing conscientious and able support from the inception to the completion of the project.

John V. Yurkovich, Director
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INTRODUCTION

In recent years institutions of higher education have undergone a rapid physical growth. This has been occasioned by several factors: enrollments have risen sharply; the array of educational services demanded has broadened considerably; research activity has been stimulated to unprecedented levels; and the public service function has been expanded to a wide number of fields. This growth and expansion of institutional activities has placed a heavy stress on the physical facilities and has emphasized the need for efficient management of existing space and more systematic planning of new facilities.

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Burgeoning student enrollments, expanding curricula, and changing policies are forcing colleges and universities to review their operating methods on a continuing basis. Such constant review is necessary in order that enrollments can be increased through more efficient utilization of existing spaces and to insure that expansion funds will provide the most useful facilities. It is also essential to effective planning of new colleges and universities which may be required to meet present and future needs of entire geographic areas.

The task of rearranging or providing new space to meet program needs is generally delegated to specialists in the area of physical facilities. Many institutions, however, have inadequate organization and personnel in this management area to evaluate space needs on a day-by-day basis and must call on faculty and staff at given intervals to assist in the task. Systems of higher education which provide capital outlay funds to more than one campus, school, or college face a similar problem. They are often forced to delegate capital building programming to non-specialists. Basically an outgrowth of this kind of space control, "log-rolling" in legislatures, "pressure-plays" by schools or departments, and other "jousting" for capital outlay funds have become commonplace throughout the country. It is quite difficult for a layman, whether a member of a governing board or a legislature, to make the final judgment as to the proper allocation of capital outlay funds when the improper allocation of these funds may severely limit programs of instruction. Optimum use of expansion dollars implies construction of the most urgent and useful kinds of spaces needed to continuously balance the educational facility at its full potential. More specific guidelines for planning physical facilities are needed to insure that educational funds in the future will be expended in a manner which will maximize their benefit to programs of higher education.

General Considerations

Many considerations are inherent in the development of a program of space management and planning for an institution. Foremost in importance is the identification of the uses which the space and space-related information will serve. The data systems, namely the physical facilities inventory, room utilization study, student projections, and staff projections, need to be considered independently in terms of their potential uses and together for the purpose of projecting future space requirements. The levels of planning (departmental, divisional and/or institutional) which the information is to serve must be given careful consideration. Institutional reporting can be better organized and the requirements more efficiently filled when information systems are designed and implemented to generate data in prescribed forms at specific intervals of time. Such organization of information should serve internal reporting and be readily translatable into forms required for external reporting to state governing boards or federal agencies. It can support applications for funds under the Titles of the Higher Education Facilities Act as well as from other federal or private granting agencies. Space information may be useful to business office personnel for performing analyses of maintenance costs or depreciation related to facilities, or for prorating and relating institutional space to the sources of support of programs and research carried on within an institution.

Classifying Institutional Space

An important consideration of any space management organization is its space classification system. Not only does such a system facilitate various reporting and utilization or allocation studies, but it also determines the kind of information that the institution will have at its disposal. It determines the form, and in large degree, the usefulness of the information gathered in inventories and developed in projections and analyses.

Because of its central position, the derivation of the space classification system should be a reflection of all of the potential uses of the space information. There is no simple procedure for making such reflections and no simple way of determining an appropriate classification system. The study group cannot even recommend that the one evolved for the case study institution should be unconditionally adopted by others. An effective space management program must make many considerations, often unique to its institution, in evolving its space classification system. This study will attempt to point out some of those considerations.

Attention should be called to the current emphasis at the national level on uniform classification and reporting of space which has major implications for institutional space programs and should be kept in view.

The Inventory of Physical Space

The physical facilities inventory serves a number of useful purposes. A record of the existing space assigned to each department is required for evaluating space; the space inventory by department can aid a departmental person charged with assigning spaces within a department; and the inventory can be a current source of space information when needed by a department in applying for external research or program support. The inventory should be a useful tool for administrative planning at all levels within the institution.

A number of considerations need to be made in developing a physical facilities inventory system. Assuming that a space classification system has been set up for the institution, it must be particularly assured that the space will be inventoried and classified in a manner which will be compatible with the system for projecting space needs. The codes and names of buildings, divisions and departments set up for the inventory should be uniform with those employed by other agencies within the institution if the effort invested in operation, planning, reporting, etc., is to be meaningful and useful on an institution-wide basis. It must be determined whether room areas will be secured by scaling construction drawings, by physically measuring the spaces, or by some combination of the two methods. A major consideration is the amount of information which is to be included. A perpetual space inventory must be supported by an efficient file maintenance system; thus it should be recognized that a level of detail may be built into the inventory which may overburden the system and make it unsound both operationally and economically.

The Goals and Problems of Utilization Studies

Utilization studies are conducted by most institutions. Standards developed for these studies must be viewed as goals and need to be developed by an institution in the light of its particular facilities and instructional programs. The findings of a utilization study should be analyzed in relation to the institution's prescribed goals and compared with the results of previous studies. Too commonly, both goals and findings are used mainly as a basis for comparison with other institutions. Utilization standards must take into account changes in educational policies, teaching methods, instructional equipment, etc., at the particular institution. For example, changes in class size or the length of the teaching week, an increase in evening programs, or an increase in the number of specialized courses requiring special facilities will affect the rates of utilization of the instructional spaces. Institutions differ in their educational policies, programs, etc., and the variation in utilization goals and rates between institutions within a state and across the nation implies that a variety of educational needs are being met; consequently, comparisons of utilization standards and rates between institutions may have little validity.

Space utilization studies have been done, for the most part, manually, the rates of utilization being arrived at by analyzing the data recorded on a room-by-room basis. Such an approach is commonly subject to serious errors. More recently, institutions have been moving toward computerized methods inasmuch as the machine can sort the timetable data into a time-day configuration for each room, merge these data with a computerized room inventory file, and print out the desired utilization information. Such a method may tie in with timetable construction or computer scheduling of students and thus eliminate unnecessary duplication of effort in the compilation and submission of data. Computerization can afford a higher level of accuracy as a result of computer audits and expedite what has become a major task at many institutions.

Generators of Space Needs

In the development of a methodology for projecting space, a significant consideration is an understanding of what generates space need. It is known that a class, department or research center has a space need, but to systematically and accurately project that need requires a clear understanding of what it is generated by.

One recognizes that a space is used to enclose some activity or thing. Carrying this point further, since an activity is primarily a product of the people engaged in the activity and the equipment they have at their disposal, it becomes evident that an activity or equipment to be housed is most predictable from the personnel using the space and the equipment that is inside of that space. To generalize, it can be said that space need is generated by people and equipment. Consequently, space types should be defined in terms of people and equipment.

A deduction coming from the recognition that people and equipment are the generators of space need is that as new equipment becomes available, or when one type of personnel starts using equipment not used earlier, space needs change. Examples of this are prevalent. The nuclear accelerator was originally a research tool; its coming into existence required new considerations in research space needs. Now the accelerator is becoming an instructional tool -- a laboratory for the instruction of students -- and generates a different space need. Computers, language laboratories, etc., are similar examples. Thus, as equipment varies or the equipment-personnel relationship varies, so space needs vary. These changes in need must be accommodated in the space classification system and in the space factors applied to the classification for projections of space. Such adaptability is an important criterion for any space classification system.

Student and Staff Projections

In order to project space a technique must be in hand for predicting students and staff by the various units upon which the space factors are based. Instructional facilities such as classrooms, laboratories and studios relate to student contact hours of instruction; research space relates to full time equivalent (FTE) graduate enrollments; and spaces such as student service areas, dining facilities and residential facilities relate to headcount enrollment. In addition, the number and type of academic staff needing space relate to FTE students by level and need to be projected on the basis of student-staff ratios. For projecting other types of staff and their space needs, some method should be derived for relating these to enrollment if at all practicable.

Detail vs. Generality

Some mention has been made of the detail of a physical facilities inventory and its implications for file maintenance. Similarly, the level of detail desired in the total process of space management and planning must be examined. Should work be done in "ball park" figures, or should accuracy be emphasized with its corresponding demand for detail?

There are many needs which general figures can satisfy. Such information is easily understood by the lay person and is a means of quick communication of space information. Reporting to state and federal agencies has normally been straightforward and general. Greater detail, however, is being requested by these external groups as each year passes. Detailed queries are sometimes made by legislators or governing boards which often are the result of the growing concern for, and understanding of, the problems of physical facilities planning. Detailed information is also needed for internal management and planning of facilities and is justifiable to the extent that the maintenance of the data is feasible and economically sound. Other considerations that apply are: the likely stability of the reporting requirements that an institution must fulfill. Enough detail should be collected so that changes in reporting requirements will not necessitate complete reorganization of the system; if the gathering of detailed information is contemplated, it must be structured in a form that allows easy accessability; and though detailed information may be desirable, it is only possible if budget and personnel are available to gather and maintain it. Institutions presently are so hard pressed to collect information which is desperately needed that the question of optimization of detail is receiving little consideration. The ultimate balance, however, needs to be determined.

Computer vs. Manual Data Processing

The goal of this project was the development of a computerized methodology for the projection of physical facilities requirements. The need for developing such an approach was clear. Space projections were involving growing numbers of students and staff and the principal task was the processing of large quantities of data. Procedures for making projections were becoming better defined and more systematic in their nature. The increasing need for the systematic processing of personnel and space data was only one aspect of the general information processing needs that existed on burgeoning campuses across the nation. Computer techniques were being applied to scheduling, room assignment and budgetting. Space management and planning represented only one part of a large and growing need for computer processing of data. In view of such factors, computerization of the methodology for the case study institution proved to be both feasible and economically sound. The availability of electronic data processing equipment or services, however, is a major consideration for an institution desiring to implement computer techniques in space management and planning.

Objectives of the Project

The primary goal of this project was the development of a computerized methodology for determining the physical facilities requirements of a large university. Specifically, the research was to include the development, implementation and testing of: (a) a space classification system and related space factors; (b) a perpetual space inventory system; (c) room utilization study procedures; (d) a system for projecting students by a set of defined measures; (e) a system for projecting staff; and (f) a system for integrating the structured input data and projecting future physical facilities requirements. The secondary goal of this project was the assessment and documentation of the applicability of the methodology to institutions varying in size and nature, through a terminal conference.

It is hoped that the information generated by this project will be of especial use to institutions embarking on formal space management and planning programs; particularly those which contemplate the use of the computer. Space management and planning is still an emerging field. As was true of the case study institution, a large number of colleges and universities need to find or train people to get on top of the problems in this field. It is to these institutions, particularly, that the report is addressed.

Inasmuch as this was a cooperative research project, it was the responsibility of the project staff (with institutional support) to develop the required computerized systems and to collect and process all of the space, student, and staff data required for institutional purposes at the case study institution as well as for the testing of the methodology. This proved to be a task of considerable magnitude. In the period of eighteen months allotted, the project was able to: (a) develop a space classification system; (b) develop a computerized space inventory system and conduct an inventory of the institution's space; (c) develop computerized procedures for conducting a room utilization study and conduct such a study for the institution; (d) develop computerized techniques for projecting students and staff and make such projections for the institution; and (e) develop a computerized method for projecting classroom, instructional laboratory, administrative and academic office and the respective service space requirements.

Because of the constraints of time and staff, the project was unable to develop a set of valid space factors which were to be derived on the basis of a station module concept. It is certain that this undertaking could be a major project in itself. In the absence of space factors and methods for projecting the full spectrum of institutional space, only the categories previously identified were projected. The development of methods for projecting the remaining categories is currently in progress at a number of institutions and requires considerable research effort.

Organization of the Report.

This report is presented in two major sections; the body and the appendix. In the minds of the project staff they are of equal importance. The body of the report discusses the many considerations inherent in the development of a space management and planning program. It presents an overview of the total methodology and describes each specific system of the methodology in some detail. The plan was to identify the components of the methodology in the body, to discuss why each is required, and to show how they are related for the ultimate purpose of projecting space requirements. The section titled "Appendixes" serves a two-fold purpose. In addition to containing the usual supporting types of information, it contains detailed guides for conducting a physical facilities inventory, conducting a room utilization study, doing enrollment projections, and structuring the required computer systems, as developed for the case study.

Method

In the initial planning of this physical facilities project it was determined that the state of the art would be carefully examined and that techniques and methods in use at other institutions would be incorporated if applicable. In this respect the methodologies developed and employed at the institutions represented by the project consultants were particularly supportive.

The project was conducted on a case study basis for two reasons: first, in order that a computerized methodology could be developed through actual experience and reported for the benefit of others; and second, so that the case study institution could be provided a methodology for which it had great need. In view of these conditions, each computerized system was tested upon development through actual application to the institution's needs.

Specifically, the project identified the needs which the space methodology was to serve, constructed and computerized the required systems, tested these systems through a case study, and documented the procedures in some detail for the report.

THE METHODOLOGY

In this presentation the reader is referred to the flow chart on page 11 which gives a general overview of the methodology. It identifies the systems developed in the project and shows their interrelationships in the implementation of the methodology. The space classification system and its relatedness to space reporting, evolving space factors, and projecting space needs; a method for deriving space factors; the systems for conducting a physical facilities inventory and room utilization study and their inherent considerations and uses; and systems for projecting and relating students and staff to space needs are all discussed in some detail in this section. The projection of space needs by several space categories by department, division and institution is also described as is a method for deriving the projected space requirements by department, division and institution.

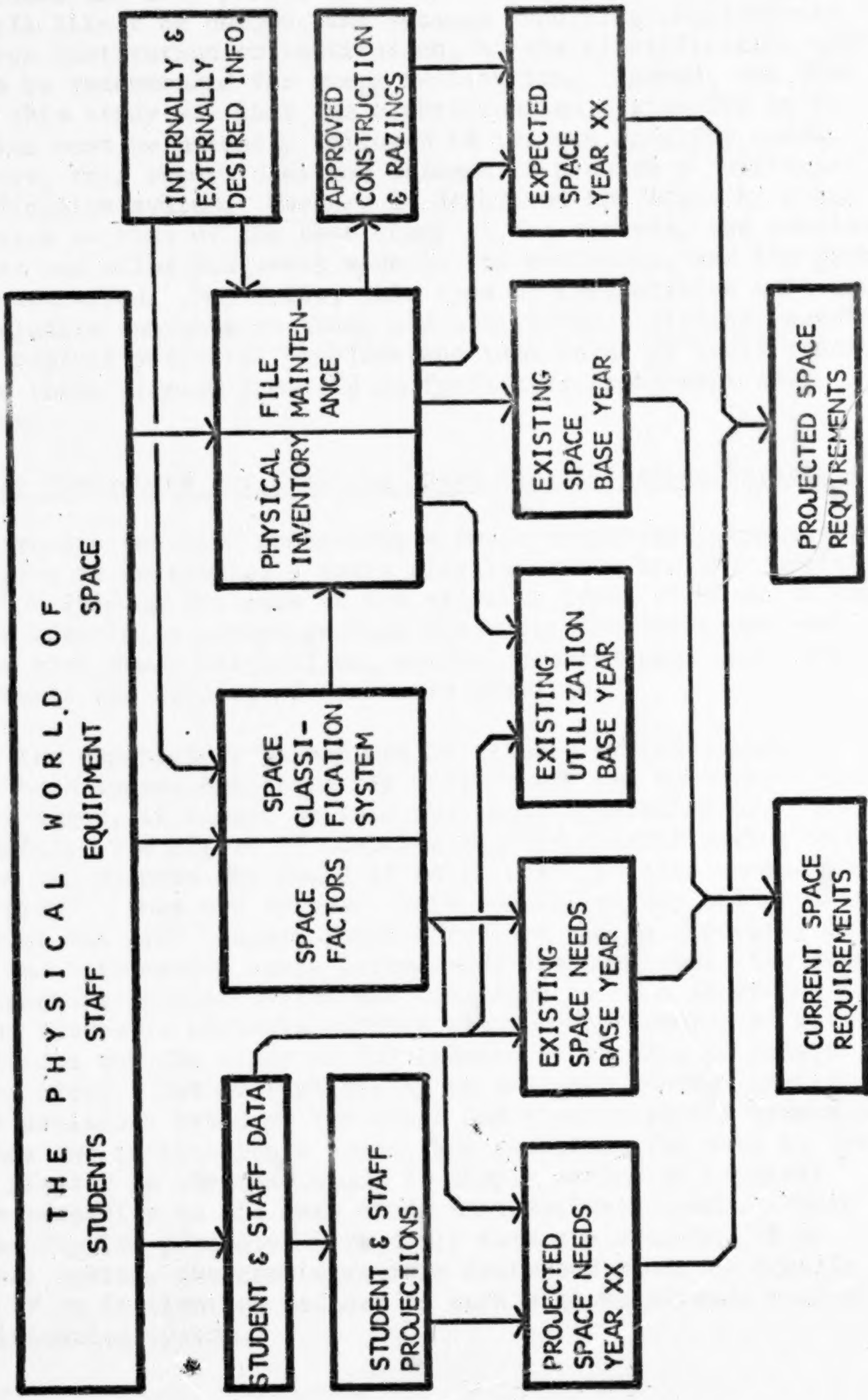
The Space Classification System

A consideration for any facilities management and planning organization is its space classification system. After all inventories, utilization studies, analyses and projections have been made, it is the classification system that largely determines the form and usefulness of the information and ultimately the success of the organization's efforts.

The space classification system must be able to structure information to respond to the many uses for which it is applied. It must be able to order the required information needed in reporting to state and federal agencies. It determines the units in which space is projected and thus influences the accuracy and usefulness of projections. It must be able to provide for useful space analyses between departments or between the campuses of a university system. These represent the most general uses of the space classification system. Besides these, the classification system may possibly be used in conjunction with the space factors to evaluate space requests and requirements. Thus, they become an integral part of the space standards within an institution or a group of institutions. A classification system oriented solely towards one of these uses will be of little value in achieving the others; thus space classifications determined by a particular set of reporting categories alone will not likely be ideal for other uses.

CHART ONE

AN OVERVIEW OF THE METHODOLOGY


THE PHYSICAL WORLD OF
STUDENTS STAFF EQUIPMENT SPACE
STUDENT & STAFF DATA
STUDENT & STAFF PROJECTIONS
SPACE FACTORS
SPACE CLASSI-FICATION SYSTEM
PHYSICAL INVENTORY
FILE MAINTEN-ANCE
INTERNALLY & EXTERNALLY DESIRED INFO.
APPROVED CONSTRUCTION & RAZINGS
PROJECTED SPACE NEEDS YEAR XX
EXISTING SPACE NEEDS BASE YEAR
EXISTING UTILIZATION BASE YEAR
EXISTING SPACE BASE YEAR
EXPECTED SPACE YEAR XX
CURRENT SPACE REQUIREMENTS
PROJECTED SPACE REQUIREMENTS

Because the uses put to space information by each institution will likely be unique, and because reporting requirements vary from institution to institution, no one classification system can be recommended for every institution. Indeed, one finding of this study was that the classification system for an institution must be uniquely tailored to its own specific needs. Therefore, this report does not attempt to provide a "universal" classification system. Rather, it describes the logic by which one system -- that of the case study -- was evolved, the considerations and value judgments made in its evolution, and the problems encountered. Hopefully, this type of presentation will provide valuable insights to those who anticipate a similar endeavor. It may suggest potential problems and some means of their resolution to those already immersed in facilities management and planning.

Possible Procedures for Evolving Space Classification Systems

There are two main procedures a space management organization may follow in developing a space classification system: evolving their own from an analysis of the existing types of space on campus; or adapting a system evolved elsewhere for their own use. For the case study institution, both procedures were used, and the efforts and results of each were compared.

If the experiences gained can be assumed typical, then, though both approaches certainly offer their own advantages and disadvantages, it cannot be said that both approaches are equally successful. The effort of adapting another classification system to ones own purpose was found to be at least as time consuming as developing ones own system. This conclusion may change as the "state of the art" becomes further refined and as reporting criteria and information needs become more standardized. The reason that adapting another system did not prove to be a short-cut is that no system is workable until a clear understanding of its definitions and the kinds of information it is able to relate becomes clear. Rather than trying to decipher another institution's decisions based on its needs and simultaneously determining ones own institution's needs, and comparing the two, it was found simpler in the case study to simply evolve an original system according to the case study institution's needs. While the description presented here deals with the evolving of an original system, the considerations described would be equally valid if an institution decided to work with an already evolved classification system.

The procedure to be described, and its logic, is not an explanation of what the study group systematically set about doing. Only after nearly completing the derivation of space categories for the case study and much discussion as to what was sought, did the study group come to the realizations set down here. But, if the opportunity to go through the procedure of deriving space categories arose again, the logic described would be consciously and systematically followed. It was what the group tried instinctively to do in deriving its present system.

A Suggested Procedure for Deriving a Space Classification System

Any space classification system is ultimately a means for grouping together individual spaces. Thus, any method should begin its derivation with a consideration of the individual spaces themselves. The approach described here follows this premise and can be considered a means for grouping what are, in reality, unique and individual spaces. The general procedure is presented in flow chart form on page 14.

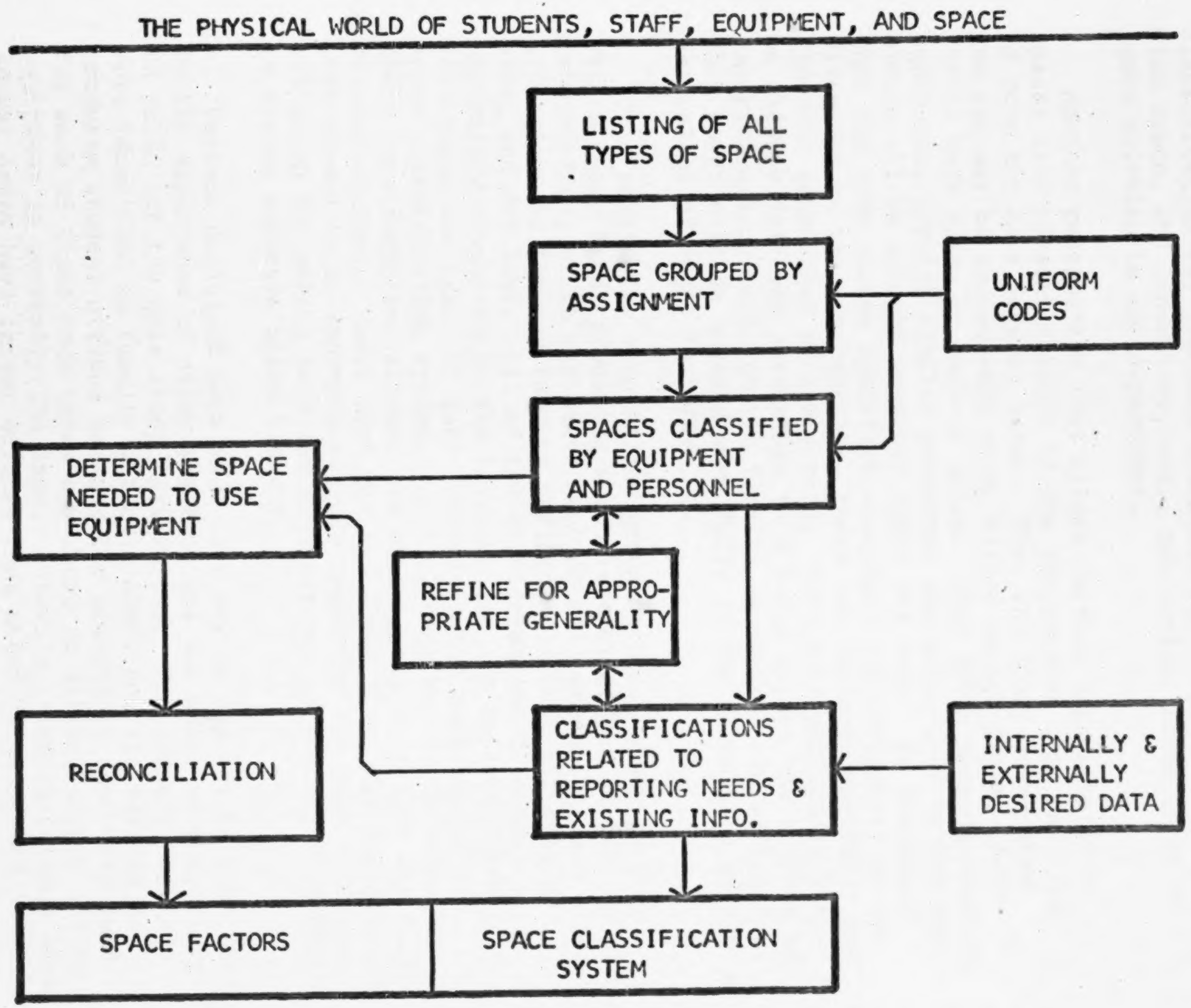
A valuable beginning point in determining any final space classification system, then, is to identify all the types of space that exist on a campus and the names that might be used to designate them. These may be taken from the **programs** for recently built facilities or they may be taken from existing building plans. A huge list can be so generated yet it will not be complete. Such a list indicates the types of space that must be organized into one manageable system, and provides a valuable beginning point from which to evolve a final classification system. The method used in the case study, which is described herein, starts with this huge beginning list of every type of space existing on campus, then applies various grouping criteria to evolve the final categories.

Information Requirements That Affect the Form of the Classification System

One requirement made of any space classification system is that it must allow the comparison of space by departments. This means that each space should be identified by the department to which it is assigned. The code or designation, then, which reflects assignment supports the space classification system. This should be the already existing division and department identification code used by other administrative units.

CHART TWO

A METHOD FOR DERIVING SPACE CLASSIFICATIONS


THE PHYSICAL WORLD OF STUDENTS, STAFF, EQUIPMENT, AND SPACE
LISTING OF ALL TYPES OF SPACE
SPACE GROUPED BY ASSIGNMENT
UNIFORM CODES
SPACES CLASSIFIED BY EQUIPMENT AND PERSONNEL
DETERMINE SPACE NEEDED TO USE EQUIPMENT
REFINE FOR APPROPRIATE GENERALITY
CLASSIFICATIONS RELATED TO REPORTING NEEDS & EXISTING INFO.
INTERNALLY & EXTERNALLY DESIRED DATA
RECONCILIATION
SPACE FACTORS
SPACE CLASSIFICATION SYSTEM

Because this code identifies all space by department, spaces repetitive to each department can be grouped together. Thus one classification for graduate assistant offices, work rooms, reception space, dry laboratory, etc., can include these types of space existing in any department.

Another recognition that allows further organization of spaces into classifications is the recognition that one type of room may have several names. Thus one space being used one way may be called work room, office support room, secretarial work room, or back-up space. Thus rooms housing similar equipment, serving similar personnel and being used in one way, should all be brought together under one name. We recommend that the name chosen specifies equipment and personnel; as was discussed in the introduction, these two criteria partially define the generation of space need. That this particular step be closely followed determines to a large degree the success of any projections based on the finally determined classification. This point will be treated more fully in the discussion of the derivation of space factors.

This particular step in the grouping process may be done with a heavy hand, producing such classifications as offices and laboratories, or it may allow much detail, producing such classifications as tenured faculty offices, clerical offices, wet labs, and dry labs. All of the considerations of detail vs. generality discussed in the introduction are applied first at this point and again at later points in the evolving of the space classification system. Working back and forth through these considerations allowed the study group to evolve its basic classifications. These were not its final list, but represented what seemed to be appropriate room types for the case study institution for making detailed analyses and as a basis from which to evolve accurate space factors.

Various decisions were made that may or may not be supported by the experience of other institutions but which were considered valid for the case study institution. For example, offices were identified as faculty offices, civil service offices and graduate student offices because the acceptable space standard for each of these room types was known to differ, though office equipment is generally the same. Actually, more variations were known; deans have larger offices than other faculty, and full professors usually receive larger offices than assistant professors. The room types chosen put all faculty together to minimize yearly updating and because space allocation in more detail than this would encourage "politicking". Projections for these types of personnel were also available, thus their need was realistically determined

Another decision was to differentiate between dry laboratories and wet laboratories. It was felt that the variation in space need between these two types of spaces justified their separate treatment.

Projecting Requirements

At the same time that these various detailed considerations were being made, thought was being applied to the general classifications that would best suit space projecting and reporting. It was strongly felt by the study group that any set of detailed classifications must be able to be compounded into more general classifications for the many purposes demanding quickly communicable general information. Therefore, while detailed space groupings were being made, general classifications or categories for grouping these detailed classifications were also being proposed and evaluated. This decision to develop a system having both general and detailed classifications was based upon the recognition that a system must be able to respond to a variety of information and processing needs, many of which are likely to vary over time. It was also recognized that because the final methodology was to be computerized, the ability to retrieve information of the appropriate detail in a short time was feasible. Again, this was the choice made at the case study institution, and it represents the decision of the study group for this situation only.

For the general purposes, the categories of Classroom, Instructional Laboratory, Academic Office, Physical Education, Library, Auditorium, Research Laboratory, etc., were typical of the general classifications sought. (The system finally developed for the case study is shown on page A-18.)

It was immediately recognized that the detailed classifications which came to be called room types, may sometimes overlap their placement in the more general classifications. For example, Storage Room may fall into several categories such as Classroom, Academic Office, or Library. Thus one room type may belong to several general classifications. How the room types group under the categories can be seen on page A-24. By using both detailed room types and categories, the needs of projecting, of making various detailed analyses, and of research into appropriate space factors, could be accommodated while still allowing redefinitions of space to take place in the future.

Again, these were the decisions based upon the needs of the case study institution. They may not be equally valid for other institutions.

Reporting Requirements

Two other important considerations must be applied to any final space classification system. First, a major use of a space classification system is to report its existing space situation and its space needs to other organizations. This may be solely for information purposes or may be a basis for budgetary requests. The classifications of space to be reported may be determined outside of the institution and may bear little relation to the institution's internal needs. Yet any classification system must be able to structure information in such a way as to meet these reporting needs. Sometimes included within reporting needs are utilization studies. Whether these are in terms of station utilization, room utilization, or student contact horus, the requirement of making meaningful utilization studies is also an influence on any space classification system. Because any institution reporting utilization wants to present itself in a reasonable light, several significant considerations come to bear on the classification system. Since utilization criteria do not exist for some spaces, these must be separated from those for which utilization criteria do exist. Thus rooms used for instruction, but not on a regularly scheduled basis, or spaces in which the number of stations cannot be determined, should be separated from those having scheduled use and station counts. Spaces where stations cannot be determined cannot be systematically projected. This is another reason why they should be treated separately. This consideration becomes particularly applicable in certain laboratory spaces such as greenhouses and home management houses.

Another important consideration that must be brought to bear on any space classification system would be the constraints resulting from the comparative uses made of the information. Because meaningful projections and other analyses often involve the comparison of present data with past data, these two types of information must be relatable. Comparisons of both total space and utilization may be required. This consideration exerts a strong conservative influence on any new space classification system, for it requires that the old form of information be incorporated in any new system.

It was felt by the study group that the necessity over time to change classifications encourages the method used in the case study, where detailed classifications are grouped into more general ones. The general categories can change; yet, consistant comparisons will still be possible if the detailed room types are appropriately structured.

These last considerations, of compatibility with the required reporting categories and with previous classifications and information, encouraged several changes in the case study institution's classifications. The general categories were adjusted to include present reporting classifications. This specifically called for a differentiation of research offices from instructional offices as one example.

The continual refinement of the classification system according to the considerations listed above; the need to accommodate present reporting and utilization studies; and the need to be able to relate back to old information, determined the final form of the initial classifications based upon equipment and personnel to be housed. Thus, the balanced end result was not a simple structure arising from single decisions. Even at this point, some questions exist within the minds of the study group concerning certain aspects of this classification system.

Space Factors

Developed jointly with any space classification system must be its space factors. While it might seem simpler to evolve a space classification system, then to determine the space factors that apply to these classifications afterwards, such an approach ignores any basis upon which reasonable and justifiable standards can be initially determined. As was mentioned in the introductory remarks, space needs are determined by the equipment and personnel that must be housed and the time increment associated with the use of the space. Thus, accurate and meaningful space factors can only be arrived at based upon equipment, personnel, and time. Of course this implies that the space classification system should identify space according to the factors of personnel and equipment; this was attempted in the case study.

Any space classification is a grouping together of many individual spaces with different, though related, activities and needs. There is not any one factor that will exactly suit every space within a given classification. The best that can be achieved is the determination of a factor that represents an accurate average of all the individual space needs. The ease with which this goal can be accomplished varies widely between different classifications. At best, the spaces within a classification will be responses to a few easily determined and consistant needs. At worst, each individual space within a classification can be a response to a different and unique need. In every case, though, a space factor represents an averaging of different needs. The accuracy of any space factor ultimately rests upon the correctness of the individual space needs that are determined as the inputs to a space factor, and the accuracy of the averaging procedure used to determine the final space factor.

There is no one "correct procedure" for deriving meaningful space factors. Common procedures have been either to use a factor that represents what already exists and is derived from the space inventory, or else they have been determined by a "try and see" method. While the space factors used by any institution must recognize what already exists and must in the end be approved by those who will use the spaces generated, these should not be the foundations upon which factors are based. Rather, they should be based upon needs that can be objectively determined. The procedure presented below is one way to produce objective factors. The method and examples should not be construed to be the study group's recommendations of final space factors; they are only examples of a way in which relatively objective space factors can be initially evolved.

A Method for Evolving Initial, Objective Space Factors

The greatest use of space factors is for making general analyses and projections. Thus, the need for space factors is greatest for general classifications. Such classifications include within them many different specific types of space, each with a different space need. Thus, even as simple a category as Classroom includes seminar rooms, regular classrooms, lecture halls, and auditoria, each over a range of station sizes. Each of these room types has its own range of space factor requirements which must somehow be represented in the final factor for the category.

Important information concerning the make-up of any category was available in the case study in the form of information on room types, the sub-units within each category. These are the basis for the method presented here. If no such information is readily available for making the analysis to be suggested here, then it may be gathered in a separate study or else space factors may be evolved by a "try and see" method. These seem to be the only alternatives.

Area Requirements

An initial requirement for determining an objective and appropriate space factor for a particular space classification is to list all the equipment and activities to be housed within it. After such a listing has been made, typical arrangements must be tried out on paper and an acceptable average room size for various proportions and arrangements determined. It is recommended that good planning of space should be demanded and expected in new facilities and that the space factors for an individual room type reflect this expectation.

An example of such an analysis is shown in Chart Three on page 21. A more extensive analysis of several room types is included in Appendix D. Many such analyses have already been undertaken by others. These can be used when available for determining appropriate factors.for the room types that comprise the more general space category. What often evolves for multiple-station spaces is a factor for a given room type that varies by the number of stations housed. Chart Four on page 22 shows some of the curves representing good station modules that have been determined by institutions for classrooms of various sizes.

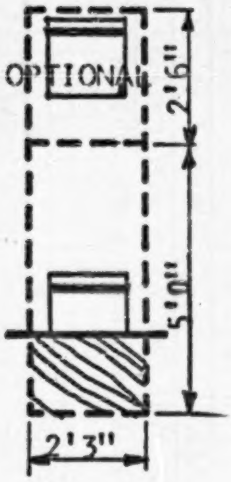
After such analyses for rooms have been accomplished, these must be translated into an allocation value per station, and related to people and/or equipment. From such an analysis initial "station modules" that seem to be meaningful starting points for refinement can be chosen. Examples of what these could be are also shown in Chart Four.

The Distribution of Space

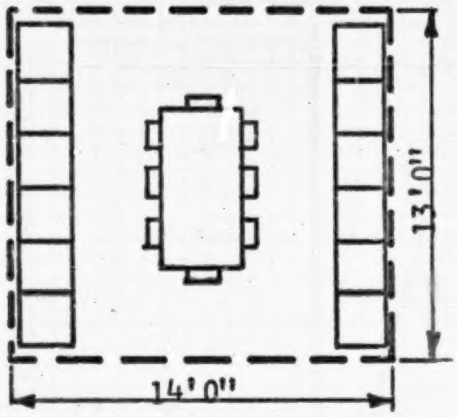
The next task is to estimate the distribution of these room types within the space category. This distribution represents the proportion of each type of space within the category and should reflect both the presently existing distribution and also institutional policy.

The existing distribution at the case study institution for the room types within the Classroom category was: Seminar Rooms 2.0%; Classrooms (0-85) 46.7%; and Lecture Halls (85+) 51.3%. These percentages represent the number of stations housed in each room type divided by the total number of stations existing in the Classroom category. These figures should be adjusted to meet the expected future changes within the institution.

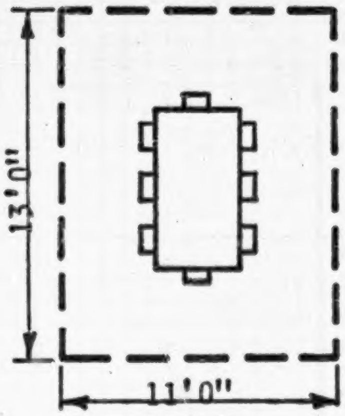
CHART THREE


OPTIONAL
2'6"
5'0"
2'3"

STATION
MODULE



20 STATIONS
9.1 SQ FT/STATION

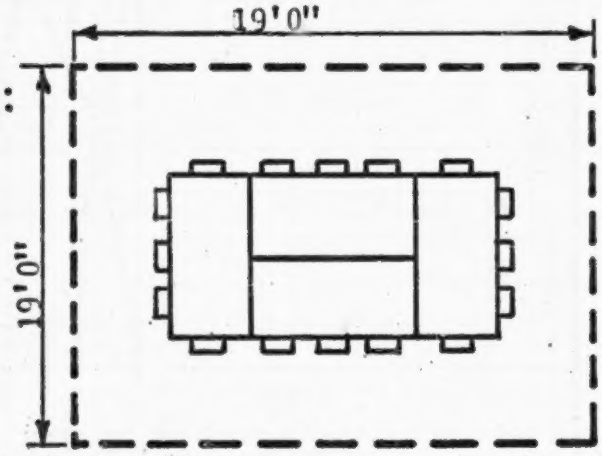


8 STATIONS
16.2 SQ FT/STATION

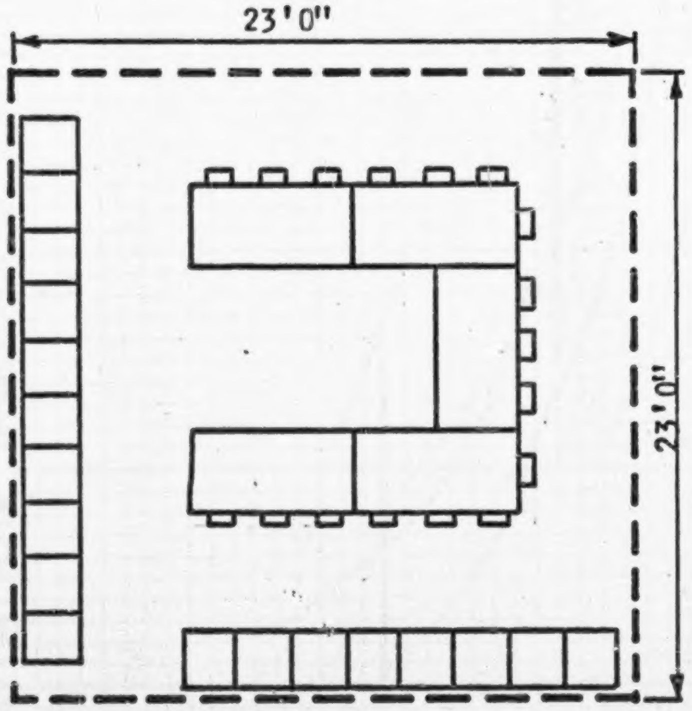
ROOM TYPE ANALYSIS: SEMINAR ROOMS

WITH 3'X 6' TABLES
AND OPTIONAL TABLET
ARM CHAIRS.

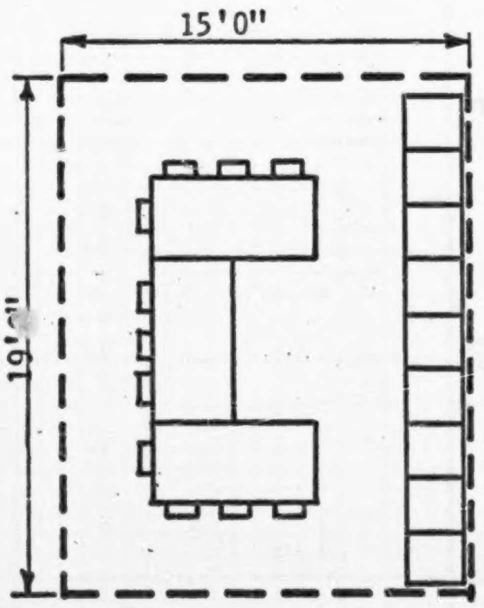
THIS IS ONLY AN EXAMPLE
AND OMITS TIME CONSIDERATIONS



16 STATIONS
16.6 SQ FT/STATION

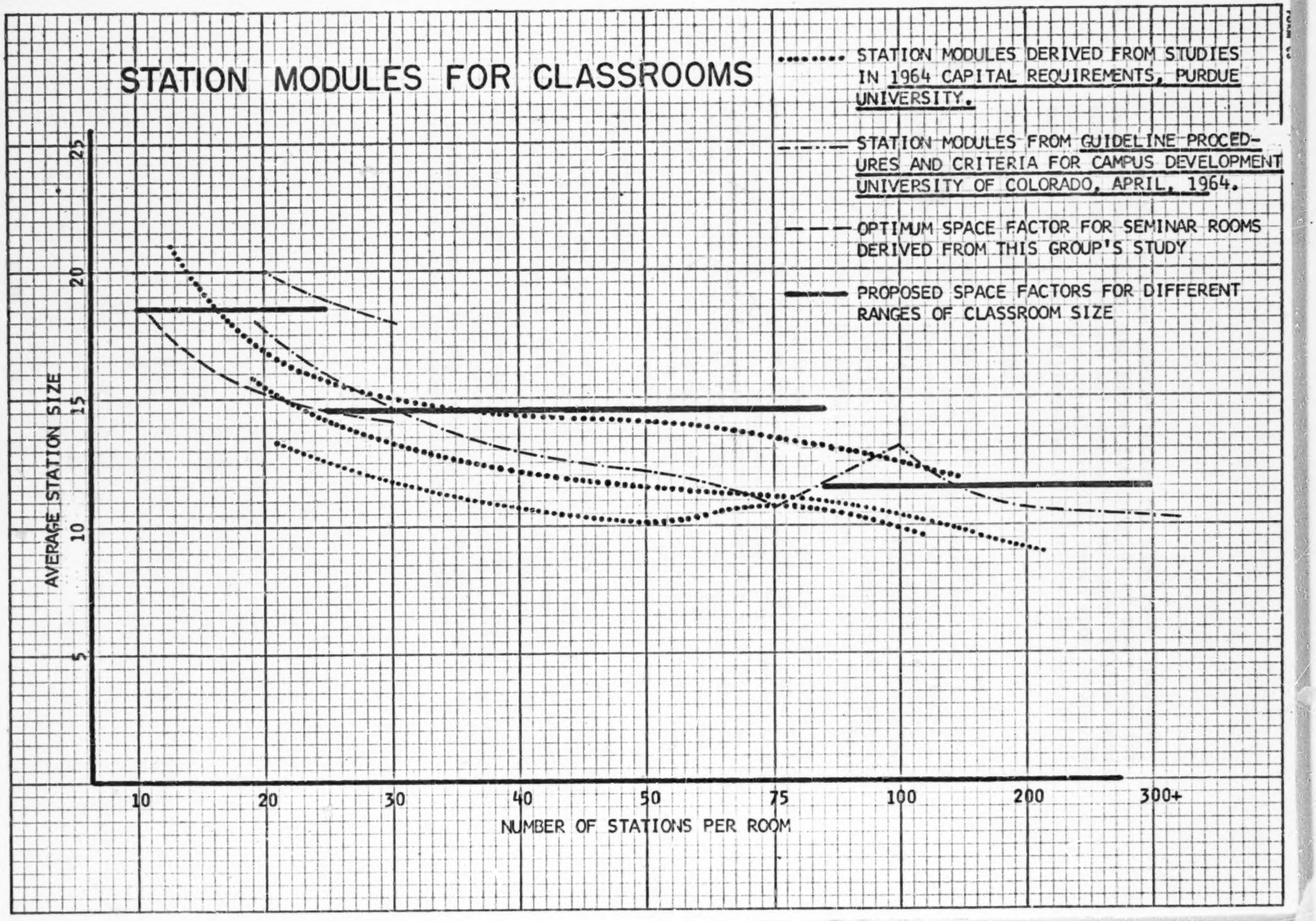


35 STATIONS
15.1 SQ FT/STATION



20 STATIONS
14.3 SQ FT/STATION

CHART FOUR


STATION MODULES FOR CLASSROOMS
STATION MODULES DERIVED FROM STUDIES IN 1964 CAPITAL REQUIREMENTS, PURDUE UNIVERSITY.
STATION MODULES FROM GUIDELINE PROCEDURES AND CRITERIA FOR CAMPUS DEVELOPMENT UNIVERSITY OF COLORADO, APRIL, 1964.
OPTIMUM SPACE FACTOR FOR SEMINAR ROOMS DERIVED FROM THIS GROUP'S STUDY
PROPOSED SPACE FACTORS FOR DIFFERENT RANGES OF CLASSROOM SIZE
AVERAGE STATION SIZE
25
20
15
10
5
10
20
30
40
50
75
100
200
300+
NUMBER OF STATIONS PER ROOM

From the "station module" chosen for each room type, and from the decision on the future distribution of space need for these types, an accurate and meaningful category "station module" can be derived. A hypothetical example, based upon several alternative decisions, is presented in Chart Five on page 24.

Utilization Considerations

Need is based on equipment, personnel and time, and thus a space factor must also include a time factor relating to the length of time that the person will use the space. Typical units for space factors are square feet per student contact hour or square feet per full time equivalent staff. Other units are also possible. (Utilization may be internally determined by policy decisions or externally imposed by higher agencies.)

The utilization goals for classrooms at the case study institution are 30 average weekly room periods of use and 67% station utilization when the rooms are in use. This defines a goal of 20 average weekly student contact hours for each station in a classroom (30 periods X 67%). Dividing the station module by the utilization goal of 20 student contact hours per station results in the final space factor for these hypothetical situations.

Reconciliation

Before any space factor can be applied, however, it must receive acceptance by the people who will be using it, and, if necessary, adjustments must be made. The purposes of such a reconciliation are to update equipment and activities that may need to be housed either in the present or forseeable future, and to make certain that the space management operation is truly serving the educational needs of the institution. Reconciliation is mandatory for an effective space management operation.

CHART FIVE

Hypothetical Determination of Three Space Factors for the Classroom Category (Does Not Include Service)

EXAMPLE ONE

Room Types	STATION MODULE (sq.ft./station)	STATION DISTRIBUTION (% within total category)	AREA
Seminar Rooms	18.5	2.0%	0.37
Classrooms (0-85)	14.5	46.7%	6.77
Lecture Halls (85+)	11.5	51.3%	5.89
		100 %	13.03 ave. sq. ft./station

Assuming 20 average weekly student contact hrs/station

$\frac{13.00}{20}$ = 0.65 sq. ft./student contact hour

EXAMPLE TWO

Room Types	STATION MODULE (sq.ft./station)	STATION DISTRIBUTION (% within total category)	AREA
Seminar Rooms	18.5	20.0%	3.7
Classrooms (0-85)	14.5	65.0%	9.4
Lecture Halls (85+)	11.5	15.0%	1.7
		100 %	14.8 ave. sq. ft./station

Assuming 20 average weekly student contact hrs/station

$\frac{14.8}{20}$ = 0.74 sq. ft./student contact hour

EXAMPLE THREE

Room Types	STATION MODULE (sq.ft./station)	STATION DISTRIBUTION (% within total category)	AREA
Seminar Rooms	18.8	20.0%	3.7
Classrooms (0-85)	14.5	65.0%	9.4
Lecture Halls (85+)	11.5	15.0%	1.7
		100 %	14.8 ave. sq. ft./station

Assuming 18 average weekly student contact hrs./station

$\frac{14.8}{18}$ = 0.82 sq. ft./student contact hour

This example showing the evolving of a space factor derived from the generators of space need represents the only method known to the study group for coming up with an initial factor that is meaningful. By meaningful is meant that this is the only method known which allows a logical derivation to be presented for any space factor. The computation and information requirements alone make questionable the practicality of such derivations. Yet the use of these derivations as a communication tool between the space management office and departments for which a building is being programmed, and to higher agencies as an explanation of the derivation of need, is a major justification for making such analyses. The procedure described is applicable to any institution. The space factors evolved from that procedure will vary from institution to institution. And indeed they must if the national system of higher education is to fulfill a variety of educational needs for a broad and diverse culture.

The study group was not able to determine final space factors for the case study institution; those that have been generated objectively have not been reconciled, and such factors have been generated thus far for only a few categories. What this section of the report has attempted to convey is a method by which initial space factors may be evolved. This procedure should be equally applicable to any space classification system.

Because the necessity of projecting space needs has only recently forced itself upon institutions of higher education across the nation, space factors and projections have mainly been a "seat-of-the-pants operation." Only recently has communication of common experiences and the beginning standardization of reporting needs allowed refinement of space factors to begin. At some time in the future it is expected that manuals incorporating analyses of the nature outlined here will be available for logically deriving space factors.

The Physical Facilities Inventory

The accurate assessment of space requirements necessitates a knowledge of both the space needs of an institution and the manner in which it is currently using its physical facilities. Since this use of facilities is dynamic to the extent that it may change from day to day, it is necessary for each institution to establish a perpetual physical facilities inventory to stay abreast of its current space situation. Any institution implementing such an inventory is faced with the question of what information to collect, how to gather it, and in what formats to report it. The intent of this section of the report is to provide insight into the many considerations which affect the structuring of an inventory system and to present some of the specific decisions which molded the case study system. These considerations and the procedural steps for establishing a perpetual, computerized, physical facilities inventory are presented in Chart Six on page 27.

Output and Input Data Requirements

In structuring an inventory system it is necessary to determine the desired output data and the formats in which they are to be reported. To accomplish this each institution must consider its own internal needs for space data, as well as the reporting requirements imposed by external agencies. Space offices require detailed room by room reports of the fundamental data, formatted to serve as informational sources when evaluating departmental requests for space, and to serve as a supporting record for summary reports submitted to external agencies. These external agencies commonly request reporting formats which are summarized by building, department, college, category, or some combination of the above. Thus, the following types of reports were considered necessary for the case study: room by room reports ordered by floor and building, by department and by category; and summarizations of the areas in each category within each building, department, college or division and for the total campus.

There are certain types of data which are fundamental to any space inventory. The basic measure of such an inventory is area. Six types of area recognized in the case study were: gross, net assignable, custodial, circulation, mechanical and construction. (Definitions of these area types appear in Pages A-2 through A-13.)[1] In addition, two other types of area used in the case study were: net non-assignable and net. (Definitions of these area types appear on page A-14.)

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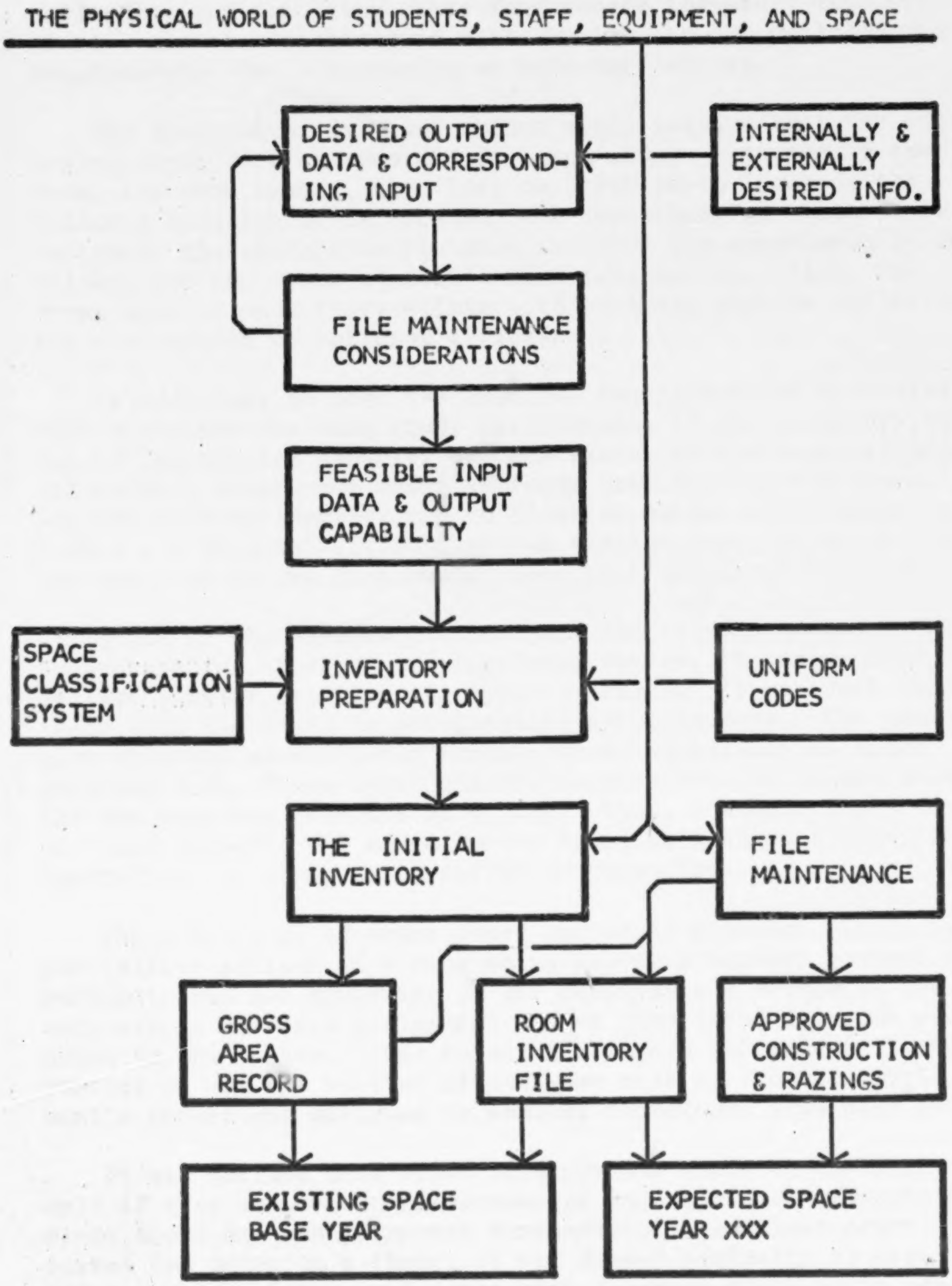
[1] These definitions based upon Classification of Building Areas, a publication of the National Academy of Sciences -- National Research Council, leave certain questions open to institutional interpretation: Should the area of mechanical spaces extending through more than one floor be measured only once or on every floor, should materials shipping and receiving rooms be classified as a part of net assignable, custodial or circulation space; should the area of canopies extending beyond the exterior walls of a building be included in the gross area, etc.?

CHART SIX

THE PHYSICAL FACILITIES INVENTORY


THE PHYSICAL WORLD OF STUDENTS, STAFF, EQUIPMENT, AND SPACE
DESIRED OUTPUT DATA & CORRESPONDING INPUT
INTERNALLY & EXTERNALLY DESIRED INFO.
FILE MAINTENANCE CONSIDERATIONS
FEASIBLE INPUT DATA & OUTPUT CAPABILITY
SPACE CLASSIFICATION SYSTEM
INVENTORY PREPARATION
UNIFORM CODES
THE INITIAL INVENTORY
FILE MAINTENANCE
GROSS AREA RECORD
ROOM INVENTORY FILE
APPROVED CONSTRUCTION & RAZINGS
EXISTING SPACE BASE YEAR
EXPECTED SPACE YEAR XXX

The space classification section discussed the fact that area data must be identified as to their assignment and their space classification or use. In addition, these data must be identified as to their physical location. However, the methods for collecting and reporting these fundamental inventory data vary widely, and each institution must examine its own policies and requirements when structuring an inventory system.

The fundamental data and output needs require that the following input data be recorded for each room: the area of the room, the room number, the floor on which it is located, the building in which it is located, the department to which it is assigned, the college or division in which the department is contained, and the space classification designation. Also, the gross area of each floor within each building must be collected for comparisons of building efficiency.

In addition, to meet the external requirement of a utilization study for the case study institution, it was necessary to record the station capacity of each classroom and instructional laboratory, to prorate areas of rooms used both instructionally and non-instructionally, and to identify suite arrangements in such a way that the entire area and station capacity of the suite was reported to the room number used in scheduling the suite.

Since it was necessary to collect the station capacity and to prorate the areas of instructional spaces, it was decided to collect similar data for all types of space. It was felt that these data would aid in establishing space factors. The proration of areas necessitated further room identification since building code, floor level and room number were no longer unique for the prorated portions of a room. Thus, a single digit numeric "card number" was added to the input data which allowed for identification of up to 10 different prorations.

The prorations of areas posed one other problem. Since the possibility existed of a room being prorated between several departments and not appearing on any department's record in its entirety, a multiple assignment and/or functional use code was added to the system. This computer assigned MAF code indicated whether or not the portion of the room missing from a department's report was assigned to another department (see page A-68).

It was decided that suite arrangements would be designated only if they occured in classrooms or instructional laboratories. Since these are non-permanent arrangements, and since several suites can occur on a floor, it was deemed necessary to designate the rooms comprising each suite with a single alpha suite identification which is discussed on page A-68.

In addition, the following data were initially collected in the case study: percent of floor slope; ceiling height; distance that radiators, pipes, pilasters, etc., extended into the room; and the dimensions of the largest rectangle which would fit into each room. It was found, however, that such items were not of sufficient value to merit their.inclusion in the perpetual inventory system of the case study.

For the purpose of simplifying the file maintenance task, it was considered advisable to include two other types of data as part of the input. These were an updating code and a serial number. The updating code was necessary in programming the computer for the three possible types of corrections: (a) deletions of records currently in the file, (b) changes in records currently in the file and (c) additions of new rooms or portions of rooms not currently in the file. A one digit updating code was used for this purpose. A serial number, used as the unique identification or control field for each record in the file, was also added so that the data in any other field could be changed. Originally, building code, floor level, room number and card number had been used as the control field, but changes in any of these data required deletion of the existing record and the addition of the corrected record in its entirety. At some institutions a similar designation is assigned manually, but the allowance of prorations in the case study would have required leaving so many blank spaces between records, that it was decided to have the computer assign this number to each record on the room inventory file in a sequential manner. The disadvantage of this approach is that the serial numbers are changed each time the file is updated. Five digits were allotted for the serial number. (The updating code and serial number are discussed in pages A-33 and A-34, respectively.)

In summary, the input data collected for each room in any computerized space inventory should include the fundamental data needs (area, room identification, assignment and space classification designations); provision for easily updating the room inventory file; and only the other data which are considered essential. The gross area of each floor in each building must also be collected.

File Maintenance Considerations

Due to the misconception that "detail" and "accuracy" are synonomous terms when applied in a space management system, almost every institution initiating an inventory attempts to collect detailed information which is nonessential; e.g., floor slope, ceiling height, etc. at the case study institution.

This common error is brought about by failure to consider the file maintenance implications of a computerized perpetual inventory system. In order to be useful, each item of information must be kept up-to-date. This involves a manual line-by-line audit of the detailed reports to check for errors. Then, each change or correction must be carefully coded and keypunched so that the computer can process it. Therefore, input data should be restricted to those items of information which are considered essential for the magnitude of the file maintenance task will soon eliminate those which are not.

More detailed information could be collected on a "one shot" basis; but experience indicates that this should not be considered until the institution has established a perpetual physical facilities inventory.

Inventory Preparation

Once the requirements for output and input data have been established, the exact form in which the data will be collected and the methods for their collection must be determined.

Uniform Codes: Numeric codes are usually used in preparing lengthy alphabetic information for machine processing. However, people may have problems in interpreting print outs which show only numeric codes and data; particularly if they are unfamiliar with the codes. If alphabetic abbreviations of the names accompany the numeric codes on the print out, this problem can be alleviated. Therefore, in the case study, codes and abbreviations were used for the space classification system (both category and room type), the building designation, and the division-department designation. Samples of these are shown on pages A-18, A-24, A-15 and A-16, respectively.

The major consideration relating to codes is that they be uniform throughout the institution. This allows each institutional agency to interpret and use the data from other agencies. Since the business office at the case study institution had established building and division-department codes for its computerized accounting system, these codes were used in the case study. In addition, it was necessary to set up "dummy" division and department codes for space which was not assigned to any existing division-department designation. These were General Academic Space for classrooms; General Building Space for custodial, circulation, mechanical and restroom areas; Inactive Space for areas which were temporarily unassigned, e.g., remodelings; and Miscellaneous Space for areas which were in use but not specifically assigned to a department, e.g., telephone booths. If no building or division-department codes exist, the various institutional agencies requiring them should jointly create a uniform system.

Techniques for Collecting the Data: Before the collection of data can begin, one of the decisions that must be made is whether the area data are to be obtained by physically measuring the rooms or by performing a take-off from the construction drawings. In the case study it was decided to physically measure most of the rooms since remodelings were not shown in available construction drawings. However, it was possible to perform a take-off for those newer buildings which had not undergone remodeling. It was also possible to collect the gross area data from the available construction drawings since, for the most part, they did show changes which affected the gross area of the buildings. It should be noted that whenever take-offs are performed, an on-site inspection is necessary to assure that the construction drawings reflect the existing physical situation.

No matter which method of data collection is used, it is necessary for a space office to obtain or develop reduced floor plans for each building included in the inventory. In the case study single line drawings showing general construction features, room numbers, relative room sizes, floor level, building name and building code were developed. A sample "floor plan diagrammatic" appears on page A-51. Such a single line drawing requires less time to develop than the more conventional small scale plans showing wall thicknesses, etc., but nevertheless, performs the function of relating the relative size and physical location of a particular room to the room number shown on a report. Great care should be exercised to insure that all information shown on the diagrammatics is in exact agreement with that recorded in the room inventory. If time allows, it would be of value to show the area of each room rather than a scale indication for the diagrammatic.

The form(s) for recording the input data and preparing them for keypunching must also be developed. Many institutions collect the data and transfer them to a multiple line, 80 column coding form with specially printed headings. However, an individual data sheet for each room was developed in the case study. (See page A-32.) This data sheet served as both the collection instrument and the coding form, and thus eliminated the possibility of errors arising from the transfer of data to a coding form.

Dimensional data were recorded for each room or space having an area defined by one or two rectnagles. Keypunching these dimensional data allowed computer computation of the areas for the "rectangular" rooms, and in this manner the time-consuming task of manually computing and checking areas with a desk calculator was by-passed for about 80% of the rooms inventoried. In addition, the blank side of the individual data sheet allowed for the sketching and recording of dimensions for each "non-rectangular" room, which aided in both the manual computation of the actual area and in the development of floor plan diagrammatics. It is also suspected that the time required for keypunching the data from this type of shaded data sheet may be less than that required for keypunching from a standard form.

If the personnel who are to perform the inventory are inexperienced (student help was used in the case study) the trial inventorying of a building is recommended in that it will help to acquaint the surveyors with the problems inherent in the process of physically inventorying space.

The Initial Inventory

The instructions for completing the room inventory data sheet appear in pages A-33 through A-40. As the space is inventoried, the forms must be assembled in sequential order, the "non-rectangular" areas computed and the codes recorded on the data sheets. Checks should be made to insure that the information on each data sheet is correct and complete and that each room is included. The data sheets are then ready for keypunching and verifying. Resulting cards are compiled onto a tape called the room inventory file. Even though extensive time has been invested in ass assuring the correctness and completeness of the data, computer audits should be made to further insure that the room inventory file is as correct as possible. The computer audits used in the case study are shown in pages A-69 and A-70.

If physical measurements are to be performed, a letter from the head of the institution should be sent to all deans and department heads requesting their cooperation and explaining the purpose of the inventory. Actual measurement should probably start with newer simpler buildings and progress to older and more complex facilities. If the inventory is extensive, the task can be divided into parts or phases so that the clean-up of the first segment can be effected simultaneously with the measuring and coding of the remaining spaces.

Unless accurate information exists on the current prorations of space it may be wise not to prorate during the initial inventory. In the case study the available data on prorations were over two years old. Therefore, the prorating of space was not done until the update with departments.

While the room inventory is being conducted, the gross area on each floor of each building should be compiled. In the case study these data were not computerized. However, it would be necessary to do so if it were desired to have the gross areas appear on the reports showing floor and building area totals.

Updating

When the data contained in the room inventory file have been internally audited, they must undergo a departmental review. During this update the departments are asked to review the data concerning the spaces currently assigned to them. (The case study guide for this departmental update is shown in pages A-65 through A-70.) Requiring departments to update these data assures a greater measure of agreement when these data are used in the evaluation of a department's request for space. After the initial room inventory file is established and updated with the departments some further work may need to be done with classrooms and instructional laboratories for purposes of the utilization study.

Existing Space

When the master room inventory file is as up-to-date and accurate as possible, the finalized reports of the existing space can be generated. (Samples of the case study room inventory reports are shown in pages A-53 through A-57.) The master room inventory file and these reports become the basis for all internal space analyses.

Approved Construction and Razings

In order to determine the amount of space which is expected to exist at some future date, it is also necessary for the institution's space management and planning agencies to keep an up-to-date record of the space which will come in through approved new construction, as well as that which will be lost through razings. Such a record of space should contain the approximate areas identified by category, department, building and the approximate date of completion or razing.

Expected Space

By relating the data contained in the master room inventory file and the record of approved construction and razings, it is possible to compute the amount of space by category which is expected to exist at some future date at the departmental, divisional and institutional levels.

File Maintenance

After a computerized perpetual inventory system is established, it is necessary to perform continual file maintenance in order to keep the record up-to-date. There are basically two phases to this file maintenance. The "supplemental update" covers that portion of the file maintenance which can be accomplished without contacting all departments within the institution. This consists of keeping the files, records and floor plan diagrammatics up-to-date with regard to changes in the amount, assignment, and use of space resulting from new construction, acquisitions, new leases, razings, cancelled leases, remodelings, reassignments and the correction of errors. A detailed discussion of these procedures and a network of their interrelationships appears in pages A-58 through A-62.

The second portion of the file maintenance task is the "institutional update." This consists of updating the master room inventory file with those changes arising from the supplemental update, and submitting the data to the departments for their review and audit. Floor plan diagrammatics should accompany the report so that they also may be audited by the departments. This departmental review and audit of the inventory should be done at least once a year. The room inventory file may need further updating for the purposes of the utilization study. After this update, new finalized reports of the existing space are generated which supercede all previous reports. A detailed discussion of these procedures and a network showing their interrelationships appear in pages A-62 through A-70.

The Utilization Study

Institutions of higher education have conducted utilization studies for a number of years. Generally, these studies have been restricted to instructional facilities and this was done in the case study. The object of utilization studies is to measure the efficiency with which existing facilities are being used. This information can aid in determining if the expected enrollments can be accommodated in the existing facilities through improved scheduling, or if additional facilities are required. When additional facilities are planned, the utilization data can also aid in determining the required number of rooms and their proper station capacities.

In the case study the measures used in determining the levels of room and station utilization were: average weekly room periods, student station utilization rate, square feet per student station, and square feet per student contact hour. The definitions of these measures and the manner in which they are determined are discussed in pages B-1 through B-3.

Utilization Goals

In order to evaluate its levels of utilization each institution should derive utilization standards or goals. Such goals should represent the optimum situation wherein utilization levels are high enough to result in a "good" fit between room capacities and section sizes, but low enough so as to minimize scheduling conflicts. A particular institution's curricular structure, instructional work loads, section sizes and general policies must be considered in defining what its utilization goals should be. Thus, utilization goals and levels of utilization which are considered appropriate for one institution may not be appropriate for another institution. For these reasons, utilization goals and levels of one institution should not be compared with those of another unless these underlying considerations are taken into account.

As was pointed out in the section on space factors, utilization goals also play an important part in the evolving of space factors for classrooms and instructional laboratories, since they represent the time element which must be applied to the station module.

Conducting the Utilization Study

In performing a utilization study the area and station capacity information for each room must be combined with the meeting time and days, and the enrollment of each class or section meeting in that particular room. Courses which are offered for less than the full semester, quarter, etc., should be included in the utilization study, but their duration should be taken into account when computing average weekly room periods. The necessary instructional information may be available from student registration records or from a timetable expanded to include the enrollment, duration, etc., for each section.

Ideally, both student registration records and departmental records should be used to establish independent files which can be used for mutual auditing. These files should contain the instructional information necessary for conducting a utilization study (see page B-3) as well as the additional data needed for the projection of enrollment by course. A file which could serve both of these purposes might be structured to contain the following items of student, course and section information: (a) the name, permanent student number, major, and classification or level of each student; (b) the department in which the course is offered, the unique course number, the duration, and the credits of each course in which the student is enrolled; and (c) the section number, type of instruction, meeting time(s) and day(s), room(s) in which the section meets, and instructor's name for each section of each course in which the student is enrolled.

This ideal approach was not feasible in the case study, however. Part of the course enrollment projection information was obtained from student registration records, while the remaining portion and the utilization data were obtained from an expanded timetable developed by the Office of the Registrar. Thus, it was not possible to audit the section enrollments as reported by departments during the compilation and updating of the expanded timetable. The contents of this expanded timetable or "departmental instructional file," and the manner in which the data were collected, updated and audited are discussed in pages B-4 through B-9.

Pre-utilization Analysis

Before the room inventory file and the departmental instructional file can be merged for generating a room utilization report, a reconciliation of the two records must be effected. Incorrect building numbers or room numbers may be contained in the instructional file for some sections. This would preclude their being brought into the study and a number of sections dropped for such a reason may significantly lower the levels of utilization. The two records which have been audited carefully to assure that all required information is contained in each, require a mutual audit to insure their compatibility. For example, a room showing a capacity of fifty stations in the room inventory file but reported as accommodating 100 or more students in the instructional file, would bear checking out.

Examples of the room utilization report and the category summarizations report are shown on pages B-11 and B-12, respectively. Although the utilization study has been discussed in terms of utilization rates, the room inventory and instructional information files can be used for doing other analyses: e.g., comparison of room capacity distribution and section size distribution; distribution of section meetings by hours of the day and days of the week; a time-day matrix showing the usage for each room, for rooms of a given range of capacities, or for rooms assigned to a given set of departments; and for doing instructional work-load analyses.

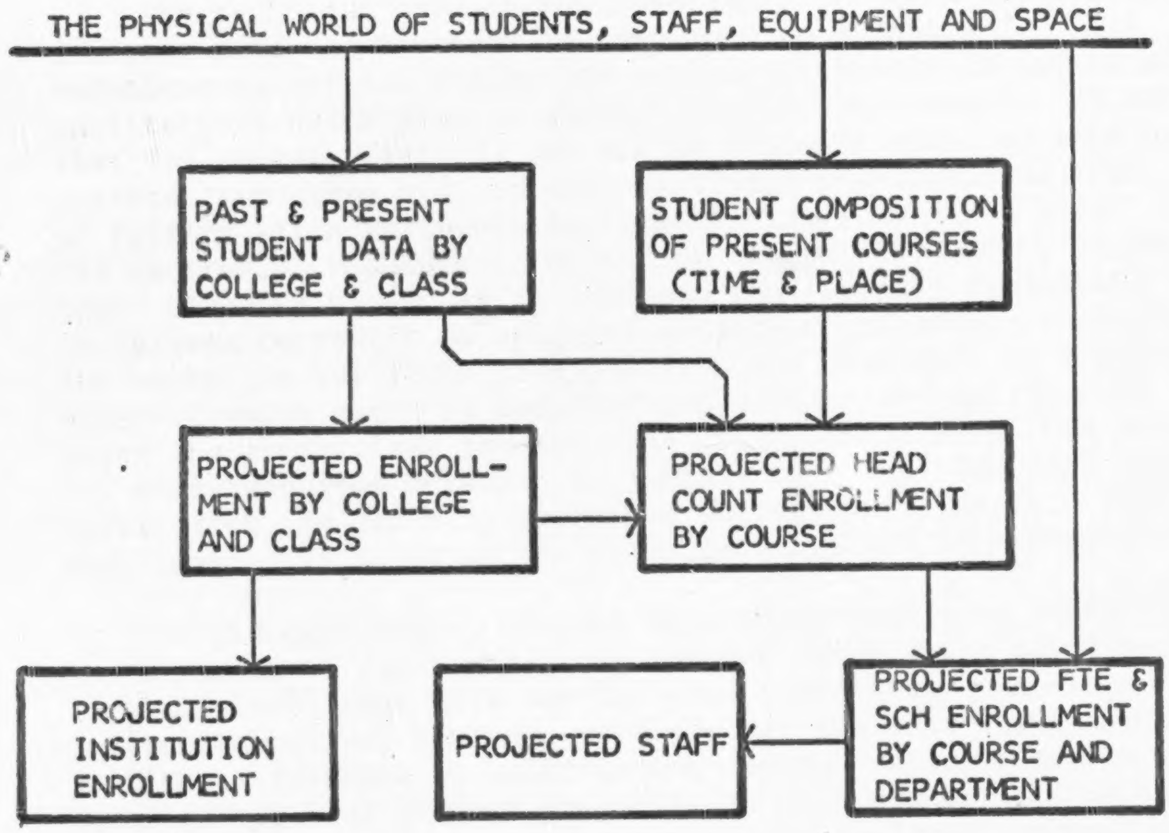
It should be realized that certain institutions, particularly the smaller, may find it impractical to computerize the instructional information for the sole purpose of conducting a utilization study. However, for institutions doing computerized scheduling or time table construction, the instructional data required for a utilization study may already be computerized and available.

Projecting Students and Staff

Any methodology for projecting space must have projected student and staff data in forms relatable to space. Institutions maintain information relative to students and staff and generally project enrollments on at least a global basis. For the purposes of making reliable staff projections, and more directly, projections of instructional space needs, techniques for arriving at more detailed and varied projections of students and staff are required. The methods employed in projecting students and staff in the case study are presented in a flow chart on page 38. The term "staff" includes all academic, administrative, civil service and other personnel requiring office space.

CHART SEVEN

METHOD FOR PROJECTING STUDENTS AND STAFF


THE PHYSICAL WORLD OF STUDENTS, STAFF, EQUIPMENT AND SPACE
PAST & PRESENT STUDENT DATA BY COLLEGE & CLASS
STUDENT COMPOSITION OF PRESENT COURSES (TIME & PLACE)
PROJECTED ENROLLMENT BY COLLEGE AND CLASS
PROJECTED HEAD COUNT ENROLLMENT BY COURSE
PROJECTED INSTITUTION ENROLLMENT
PROJECTED STAFF
PROJECTED FTE & SCH ENROLLMENT BY COURSE AND DEPARTMENT

Student Projections

For overall institutional planning, a number of ways of projecting students have proved useful. Projected headcount enrollment is necessary for projecting housing and dining facilities as well as general student service space. It may also serve as a basis for projecting some types of staff within an institution. Projected full time equivalent enrollment by student level may be used for projecting academic staff and certain administrative staff, and, at the graduate levels, for predicting research space needs. Student contact hours, projected at the course level and summed by department, are useful for projecting classroom and instructional laboratory space needs.

The technique used in the case study for arriving at the projections referred to above is described in Appendix C. This technique is not too unlike the methods presently in use at other institutions which project students in similar detail. It assumes that the course offerings and mix of students enrolled in a department's courses will remain relatively unchanged and that other factors which influence enrollment will remain the same. With the increasing emphasis on detail of student projecting to meet space planning needs, it is expected that student projection techniques currently in use will undergo considerable refinement. The technique set forth in Appendix C was developed as a general approach which might be modified and used by any institution. In doing the projections for the case study, the workers had to modify this technique because of problems unique to the case study institution, in deriving projected college enrollments. This modification is shown in the Exhibits contained in Appendix C.

In the case study, student enrollment data were available for a period of years and were used for identifying enrollment trends. Enrollment data for the year immediately preceding the projection period, however, were used as the base for the projections. Inasmuch as institutions may increasingly need more detailed types of student projections, such projections should be made a part of the overall process of enrollment projecting for the institution and be done by the office which has normally carried that responsibility.

Staff Projections

Present methods for projecting staff are relatively unsophisticated, though it is suspected that some institutions are giving the process considerable attention. The project did not have time to pursue the development of either improved student or staff projection techniques. For its purposes, the staff in academic departments were related to FTE students by department and projected on the basis of student-staff ratios derived from base year relationships. The staff in administrative operations were also related to FTE students by division, college or institution -- whichever was appropriate -- and projected on the basis of the student-staff ratios derived from base year data.

It is felt that projections of staff in academic departments would be more reliable if an institution was able to develop staffing formulas based on FTE students by level of enrollment, e.g., lower division, upper division and graduate level, through a comprehensive analysis of educational programs, workloads, etc. It is further believed that formulas based on the relationship of staff to student contact hours by level of enrollment might prove to be the best method for projecting academic staff.

Projecting Institutional Space

In the conduct of this project a number of systems had to be developed; each one somewhat unique unto itself in terms of purpose, but an integral part of a total methodology for projecting institutional space requirements. The systems and their interrelationships have been discussed in some detail in the preceding pages.

This section discusses the procedure for deriving the space needs of a hypothetical department for the categories of Instructional Laboratory, Instructional Special Laboratory, Instructional Laboratory Service, Academic Office, Academic Office Service, Classroom, and Classroom Service, for a particular projection year. Example figures and computations are shown in Chart Eight on page 41. The section further describes the procedure for aggregating and adjusting the proejcted space needs, by taking into account the information in the room inventory file and the record of approved construction and razings, and deriving the projected space requirements for a department, division or the institution.

Projecting Departmental Space Needs

The projection of students on the bases of headcount, full time equivalency, and student contact hours was discussed previously as was the projection of full time equivalent staff. Such expressions of students and staff are required for making departmental space projections.

CHART EIGHT

INSTITUTION NAME

PROJECTED SPACE NEEDS

PAGE NO. 145

DIV-DEPT CODE 00 0000
DEPT ABBREV SAMPLE

STUDENT DATA	EXISTING 1965	PROJECTED 19XX
FTE LOWER DIVISION	803.0	528.0
FTE UPPER DIVISION	205.8	297.0
FTE GRADUATE	304.0	640.0
STUDENT CONTACT HOURS -- LAB	14765.0	15889.0
STUDENT CONTACT HOURS -- NON-LAB	12988.5	11798.1

FACULTY DATA	EXISTING 1965	PROJECTED 19XX
FTE ADMINISTRATIVE STAFF	0.00	0.00
FTE ACADEMIC STAFF	188.24	199.77

SPACE CATEGORIES	SPACE FACTORS	EXISTING SPACE NEEDS 1965	PROJECTED SPACE NEEDS 19XX
INSTRUCTIONAL LABORATORY	2.41 SQ. FT./SCH -- LAB	35584	38292
INSTRUCTIONAL SPECIAL LAB	NO CHANGE FROM EXISTING AREA	230	230
INSTRUCTIONAL LAB SERVICE	42.02 PERCENT OF INSTR. LAB & SPEC. LAB	15049	16187
ADMINISTRATIVE OFFICE	120 SQ. FT./FTE STAFF	0	0
ADMINISTRATIVE OFFICE SERVICE	15 SQ. FT./FTE STAFF	0	0
ACADEMIC OFFICE	120 SQ. FT./FTE STAFF	22589	23972
ACADEMIC OFFICE SERVICE	15 SQ. FT./FTE STAFF	2824	2997
CLASSROOM	.70 SQ. FT./SCH -- NON-LAB	9092	8259
CLASSROOM SERVICE	.05 SQ. FT./SCH -- NON-LAB	649	590

The projection of space needs for a sample department on page 41 shows the FTE enrollment in the department by lower division, upper division, and graduate level; the laboratory student contact hours; the classroom student contact hours; and the FTE academic staff (faculty and supporting staff) -- for the base year and projection year. Additionally, it shows the categories of space which were projected, the space factors that were applied, and the space needs which were derived for the base year and projection year.

Instructional laboratory space was projected by multiplying the student contact hours in laboratory by a space factor derived for the particular department. Instructional special laboratory space was not projected inasmuch as such space is not programmed on a regular basis but is provided when need for such space arises. In projecting instructional laboratory service space, the ratio of that space to instructional laboratory and instructional special laboratory space was derived for the base year. This percent was applied to the projected instructional laboratory space in determining the service space need. It should be noted that this hypothetical department had no administrative office space need. Academic office space was projected by multiplying the projected FTE academic staff for the department by an office space factor. Academic office service space was projected by multiplying the FTE academic staff by an office service space factor.

Projecting Space Requirements

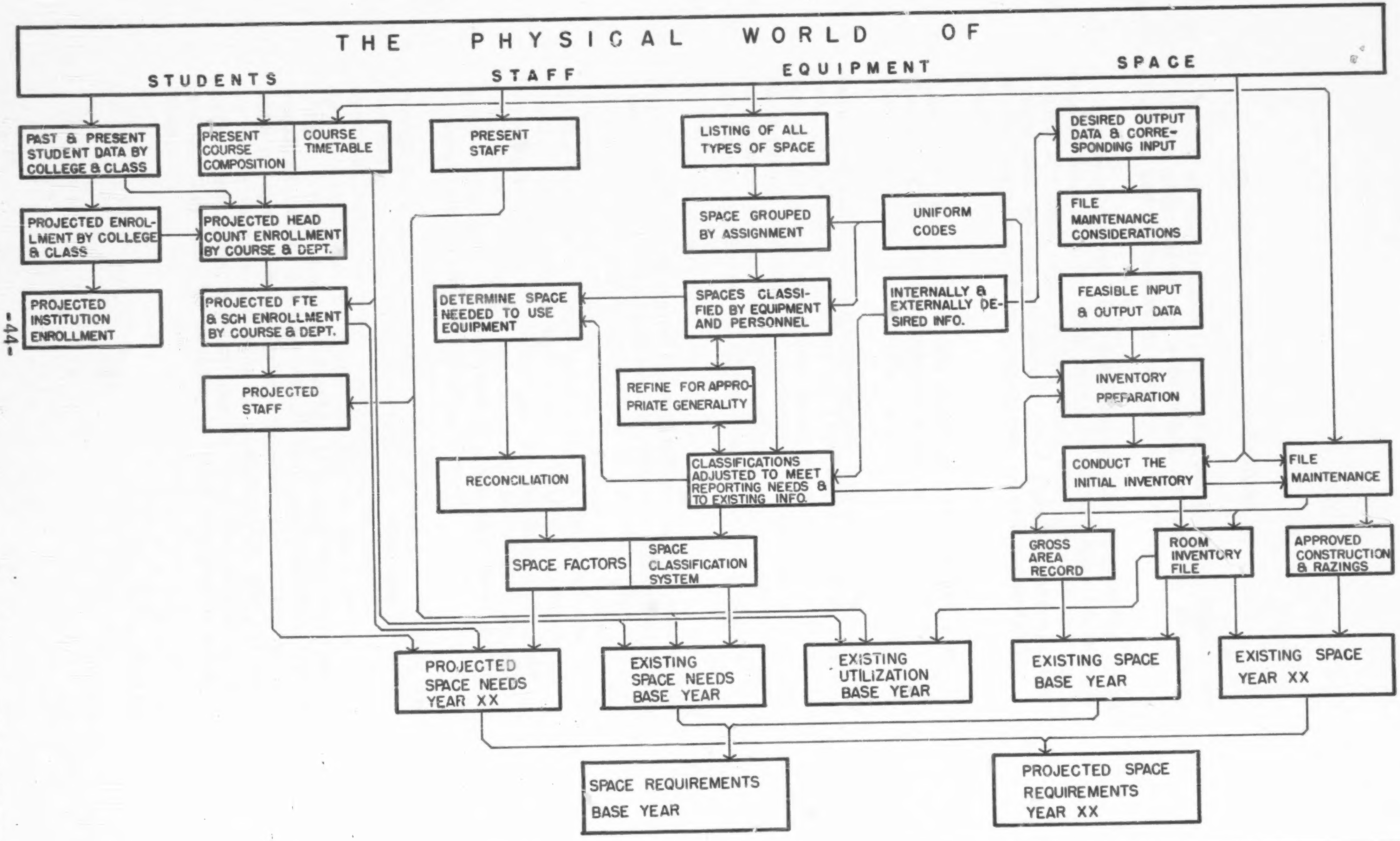
The space requirements of a department may be derived in the following manner: the space by category which the department expects to have in the projection year is determined by adding to the department's existing space inventory the space anticipated through new construction and subtracting from it the space which the department anticipates losing through razings. For the given projection year, the expected space is subtracted from the projected space needs, resulting in the department's space requirements by category. Such a projection may be useful for facilities planning at the department level.

To derive projected space requirements for an institution, the expected space by category must be determined for the projection year by adding to the institution's inventory of existing space the space contained in the record of approved construction and subtracting from the inventory the space contained in the record of approved razings; the institution's projected space needs are next derived by summing the projected departmental space needs by category; and, finally, the institution's space requirements are determined by subtracting the expected space by category from the projected space needs by category for the projection year.

The methodology developed in this cooperative research project is presented in the form of a network on page 44. The chart illustrates the systems which were developed and shows how they are organized for the purpose of projecting physical facilities requirements.

CHART NINE

METHODOLOGY FOR DETERMINING PHYSICAL FACILITIES REQUIREMENTS


THE PHYSICAL WORLD OF
STUDENTS
STAFF
EQUIPMENT
SPACE
PAST & PRESENT STUDENT DATA BY COLLEGE & CLASS
PRESENT COURSE COMPOSITION
COURSE TIMETABLE
PRESENT STAFF
LISTING OF ALL TYPES OF SPACE
DESIRED OUTPUT DATA & CORRESPONDING INPUT
PROJECTED ENROLLMENT BY COLLEGE & CLASS
PROJECTED HEAD COUNT ENROLLMENT BY COURSE & DEPT.
SPACE GROUPED BY ASSIGNMENT
UNIFORM CODES
FILE MAINTENANCE CONSIDERATIONS
PROJECTED INSTITUTION ENROLLMENT
PROJECTED FTE & SCH ENROLLMENT BY COURSE & DEPT.
DETERMINE SPACE NEEDED TO USE EQUIPMENT
SPACES CLASSIFIED BY EQUIPMENT AND PERSONNEL
INTERNALLY & EXTERNALLY DESIRED INFO.
FEASIBLE INPUT & OUTPUT DATA
PROJECTED STAFF
REFINE FOR APPROPRIATE GENERALITY
INVENTORY PREPARATION
RECONCILIATION
CLASSIFICATIONS ADJUSTED TO MEET REPORTING NEEDS & TO EXISTING INFO.
CONDUCT THE INITIAL INVENTORY
FILE MAINTENANCE
SPACE FACTORS
SPACE CLASSIFICATION SYSTEM
GROSS AREA RECORD
ROOM INVENTORY FILE
APPROVED CONSTRUCTION & RAZINGS
PROJECTED SPACE NEEDS YEAR XX
EXISTING SPACE NEEDS BASE YEAR
EXISTING UTILIZATION BASE YEAR
EXISTING SPACE BASE YEAR
EXISTING SPACE YEAR XX
SPACE REQUIREMENTS BASE YEAR
PROJECTED SPACE REQUIREMENTS YEAR XX

CONCLUSIONS AND RECOMMENDATIONS

On the bases of the information contained in this report and the review of the methodology by a terminal conference, the following conclusions and recommendations are set forth:

1. In the development of a methodology for projecting space requirements, an optimum level of detail must be established for each data system which will provide the required information yet assure that the file maintenance of the systems will be operationally and economically feasible.

2. Code lists and information which are in uniform use throughout the institution best serve the purposes of a space operation.

3. It was found that the information needs of space management organizations varied by institution. With a variety of external reporting being required, and a variety of internal information structures which support space management at various institutions, no one space classification system is likely to meet all institutions' needs.

4. Space need is generated by activities to be housed, the time increment required for the accomplishment of these activities and the equipment to be stored. Space projections, as an anticipation of future space need, should be made using classifications that reflect the common generators of that need. This was reasonably accomplished in the case study by attempting to base projection categories and their space factors on personnel the space is assigned to, the equipment to be housed, and a time increment.

5. Though both space classifications and space factors are responses to complex considerations, they can both be systematically derived. Systematic derivation of a space classification system expedites the task of creating a system that efficiently produces the information required in its appropriate format. Systematic derivation of space factors substantiates projections based on those factors and aids in planning new facilities. Before any space factors can be used for making projections, they must be reconciled with the people using them.

6. In view of the increasing demand for space information, a perpetual space inventory is considered to be essential. Computerization of such an inventory is recommended if machine data processing equipment is available.

7. Reduced floor plans of buildings showing the physical layout, room numbers, floor level and building name are essential to the file maintenance of a perpetual space inventory. It is recommended that room areas be shown on the plans rather than a scale.

8. Individual room inventory data sheets provide desired flexibility in conducting an inventory and are efficient in the recording and calculating of room areas. It is suspected that the form used in the case study required less keypunching time than may have been required if more standard multiple line forms were used.

9. The use of student help for physically measuring building spaces proved most satisfactory. Though Engineering majors were preferred, students from other disciplines made excellent surveyors. The employment of student help is recommended.

10. The organization of the surveyors into three-man teams proved very efficient for physically inventorying building space. The trial inventorying of a building simultaneously by all teams proved beneficial in orienting the surveyors to their task.

11. An inventory of physical facilities, to be successful, must have the backing of the top campus administration.

12. Information relative to the quality of building space could aid in accomplishing more effective physical facilities planning. Thus, further research is needed to establish the manner in which such information should be collected, processed and put to use.

13. The manpower and time requirements are less for bringing in an inventory by scaling construction drawings than by physically measuring building spaces. Therefore, it is recommended that an institution having up-to-date building plans employ the scaling process. More typically, an institution may find that its file of building plans is incomplete and generally outdated, in which case it may be more expeditious and economical for the institution to physically measure those buildings for which no

plans or outdated plans exist and to scale the buildings for which up-to-date plans are available.

14. The formats of output reports must take into account internal and external reporting requirements and any other uses which the space information is to serve.

15. Information pertaining to completed construction, razings, leases, acquisitions, remodelings and corrections of errors should be maintained in a supplemental file and used for updating the master room inventory file at suitable intervals during the year.

16. The space inventory should be submitted to the departments for audit and updating at least once a year. It is recommended that the space office representatives work with formally designated departmental space representatives. This should be done by personal contact the first few times.

17. For the purpose of establishing the amount of space which an institution expects to have in a given year in the future, a record of approved construction and razings must be maintained.

18. Utilization standards or goals must be developed in relation to an institution's curricular structure, desired section sizes, instructional workloads and general educational policies. The goals must take into account the space factors derived for classrooms and instructional laboratories, recognizing that the latter may vary by discipline.

19. Comparisons of utilization goals and rates between institutions may have little validity in view of the differences in educational policies, programs, etc.

20. Institutions having heavy evening programs should determine rates of utilization of instructional facilities for the day program, evening program and for the day and evening programs combined.

21. Although a utilization study is primarily concerned with the levels of use of instructional facilities, the room inventory and instructional data files can be used for making other meaningful analyses, e.g., a comparison of room capacity and section size distribution; the distribution of section meetings by hours of the day and days

of the week; a time-day matrix showing the usage for each room, for rooms of a given range of capacities, or for rooms assigned to particular departments; and for doing instructional workload analyses.

22. For the purposes of a room utilization study, a student registration data file and an expanded timetable reflecting departmental enrollment data should both be developed in order that the data can be mutually audited.

23. The instructional data must be reconciled with the room inventory data before the two records can be merged to generate the utilization reports. It is recommended that the room utilization study be computerized if feasible.

24. Non-scheduled activities encroach upon instructional spaces. Provision must be made for taking such activities into account when conducting a room utilization study.

25. For the purposes of projecting both staff and physical facilities requirements, students must be projected on the bases of head count enrollment, full time equivalent enrollment, and student contact hours. In order to project space needs, staff at the department level and student enrollments at the course level by department need to be projected. It is recommended that staffing formulas be developed based on FTE students or student contact hours by level of enrollment, e.g., lower division, upper division and graduate.

26. The student projection techniques in the case study used either intuitive or straight line approaches. Research is needed to determine if more sophisticated approaches would result in more systematic and accurate enrollment projections. Hopefully, variables such as curricular changes, program requirements, student preferences, course popularity, etc., could be taken into account, properly weighted and incorporated into such a projection technique.

27. The systems of the space classification, physical facilities inventory, room utilization study, student projections, and staff projections must be developed in relation to each other and the ultimate goal of their organization into a methodology for projecting space requirements kept in view.

28. The projection of research space is a major problem. The availability of funds for research and the tremendous growth of this function pose major space problems for institutions of higher education. A reliable method for assessing and projecting research space needs is greatly needed.

29. The methodology developed in this project is applicable to any institution, but each system contained therein may require modification to reflect the particular institution's unique needs and capabilities as well as the present form of its data and uniform codes. Thus, it will probably be necessary for an institution to develop its own computer programs for processing the data.

30. Excellent bibliographies relative to physical facilities planning and space utilization are contained in the College and University Physical Facilities Series publications of the Division of Higher Education, Office of Education, U.S. Department of Health, Education and Welfare.

SUMMARY

Introduction

The growth and expansion of institutional functions and activities have placed a heavy stress on physical facilities, emphasizing the need for more efficient management of existing space and more systematic planning of new facilities. Effective management of an institution requires a continuous evaluation of existing facilities and the constant realignment of their use to properly accommodate burgeoning enrollments, expanding curricula, and changing policies and teaching methods. Such constant review is also essential to effective planning of new colleges and universities which may be required to meet present and future needs of entire geographic areas.

It is recognized that specialization and organization in the area of physical facilities are becoming increasingly essential to effective administration of institutions of higher education. Relatively general methods have existed to guide decision making in this management area. More specific guidelines for managing and planning physical facilities are needed to insure that educational funds in the future will be expended in a manner which will maximize their benefit to programs of higher education.

The primary goal of this project was the development of a computerized methodology for determining the physical facilities requirements of a large university. Specifically, the research included the development, implementation and testing of: (a) a space classification system; (b) a perpetual space inventory system; (c) a system for conducting a room utilization study; (d) a system for projecting students by a set of defined measures; (e) a system for projecting staff; and (f) a system for integrating the structured input data and projecting future physical facilities requirements. The secondary goal of the project was the assessment of the applicability of the methodology to institutions varying in size and nature. Inasmuch as this was a cooperative research project, it was the responsibility of the project staff--with institutional support--to develop the required computerized systems; to collect and process all of the required space, student, and staff data; and to test each system upon development through actual application to the institution's needs.

It is hoped that the information generated by this project will be of especial use to institutions embarking on formal space management and planning programs; particularly those which contemplate the use of the computer. In the initial planning of this project it was determined that the state of the art would be carefully examined and that techniques and methods in use at other institutions would be incorporated if applicable. In this respect the methodologies developed and employed at the institutions represented by the project consultants were particularly supportive. The report of this project is presented in two major sections; the body and the appendix. In the minds of the project staff they are of equal importance. The body of the report discusses the many considerations inherent in the development of a space management and planning program. It presents an overview of the total methodology, describes each specific system, and finally organizes the several systems in the form of a network for the purpose of projecting physical facilities requirements. The section titled "Appendixes" serves a two-fold purpose. In addition to containing the usual supporting types of information, it contains detailed guides for implementing the computerized systems incorporated in the methodology.

The Methodology

Foremost in importance in the development of a program of space management and planning is the identification of the uses which the space and space-related information will serve. The required data systems need to be considered independently in terms of their potential uses and together for the ultimate purpose of projecting space requirements. The levels of planning which the data are to serve must be given careful consideration. Institutional reporting can be better organized and the requirements more efficiently filled when information systems are designed and implemented to generate data in prescribed forms at specific intervals of time. It must be assured that this organization of information will serve internal reporting and be readily translatable into forms required for external reporting to state governing boards or federal agencies.

A space classification system determines the form and usefulness of much of the information dealt with in space management operations. It must be able to properly structure and produce information likely to be desired. Because each institution has its own needs, no one space classification system will serve the needs of all. They must each evolve their own according to their individual criteria. While it is possible to evolve a space classification system by either of two methods -- evolving ones own, or adapting the system of another institution -- it was found that evolving ones own was more efficient both timewise and by the results that were obtained.

A space classification system is ultimately the grouping together of individual spaces for easier management. This grouping should be according to the type of information required. Commonly, information is required for the evaluation of space assigned to each department for each major type of activity (determined by personnel and equipment and by common utilization goals) and for the purpose of reporting to state, federal or other agencies. The classification system must be so structured that it can produce the appropriate information for these, and any other uses. The case study chose a two-level classification system based on room type and activity classification. It gathered detailed information which allowed computer sorting of the data in more general form.

Because the projecting of space needs is one use of space information, space factors should be determined jointly with a classification system. Space factors are most accurate if they are based upon the generators of space need, which is usually expressed by assignment and equipment housed. The time period of use also affects space need. Thus space factors should include personnel and equipment and a time increment in their derivation. The only method for obtaining objective space factors for general categories is to base them on more detailed knowledge concerning the make-up of the category. An example of the procedure for determining objective space factors is presented in the text. But before any space factor can be used for projecting space need, it must be reconciled with those that will use the space. Because space projections are a recent planning tool, space factors have mainly been a seat of the pants operation. Much work is needed in this area of space management.

Proper management, reporting and projecting of physical facilities requires a perpetual inventory of institutional space. In structuring an inventory system it is necessary to determine the desired output data and the formats by which they are to be reported. The output data in the case study were in the form of room by room reports ordered by floor and building, department, and category; and summarizations of room areas by category within building, department, college or division, and the institution. For each room it was necessary to collect room area, room number, floor on which the room was located, building in which the room was assigned, college or division in which the department was contained, and the space classification of the room. Station capacities were collected for all classrooms and instructional laboratories for the purpose of the utilization study. Where appropriate, rooms were prorated on the bases of multiple assignment, multiple usage, or any combination of the two. Rooms grouped together as a suite for instructional purposes were designated by a single alpha suite identification. A one digit updating code was used for deleting an existing room record, changing an existing room record, or adding a new room or portion of a room to the inventory file. A serial number was used as a unique identification or control field for each room record in the file. A perpetual space inventory must be supported by an efficient file maintenance system; thus it must be assured that the level of detail built into the inventory is sound both operationally and economically.

The preparation for conducting an inventory of physical facilities is quite extensive. A space classification system, a building code list, and a division-department code list need to be developed; each with its own numeric codes and name abbreviations for computer processing of the data. A decision must be made as to whether the area data are to be obtained by physically measuring rooms, by performing take-offs from construction drawings, or by some combination of the two methods. It is highly recommended that reduced single line drawings showing general construction features, room numbers, relative room sizes, floor level, building name, and building code be developed for all buildings to be inventoried. A form for recording the input data must be structured. In the case study an individual data sheet was used for each room inventoried. It served both as the data collection instrument and coding form. Dimensional data were recorded for each room or space having an area defined by one or two rectangles. Keypunching these data allowed for computer computation of the areas of about 80 per cent of the rooms inventoried. If the personnel who are to perform the inventory are inexperienced, the trial inventorying of a building is recommended for the purpose of acquainting the surveyors with the problems inherent in the process of physically inventorying space.

If building spaces are to be physically measured, a letter from the head of the institution should be sent to all deans, directors and department chairmen requesting their cooperation and explaining the purpose of the inventory. Actual measurement should start with newer simpler buildings and progress to older and more complex facilities. If the inventory is extensive, it may be divided into two or more phases so that the clean-up of the first segment can be effected simultaneously with the measuring and coding of the remaining spaces. As the space is inventoried, the forms must be assembled in sequential order and the "non-rectangular" areas computed and recorded on the data sheets. When the data sheets have been checked for completeness and correctness they are ready for keypunching and verifying. The resulting cards are compiled onto a tape called the room inventory file which is further audited for errors by computer. While the room inventory is being conducted, the gross area of each floor in each building should be compiled. These data may be computerized and printed out in the reports along with the other floor and building area totals. After the room inventory file has been audited internally, it must undergo a departmental review and update for the purpose of making final corrections and to insure a greater measure of agreement between the departments and the space office. When the master room inventory file is as up-to-data and accurate as possible, the final reports of the existing space can be generated. To be able to determine the amount of space which an institution expects to have at some future date, it is necessary for the space office to maintain a record of space which will come in through approved new construction as well as that which will be lost through razings. Relating these data to the current inventory of existing space makes it possible to compute the amount of space by category that an institution may expect to have at some date in the future.

When a computerized perpetual inventory system has been implemented, a continual file maintenance is required to keep the inventory up-to-date. Essentially, the file maintenance is conducted in two phases: the "supplemental update", which involves the maintenance that can be done internally by the space office; and the "institutional update", which calls for a review and updating of the master room inventory file by the departments. Following the update with departments, which should be done annually at least, final reports of the existing space are generated which supercede all other reports.

Institutions of higher education generally conduct utilization studies of classrooms and instructional laboratories; the main purpose being to measure the efficiency with which existing facilities are being used. The information can aid in determining if expected enrollments can be accommodated in existing facilities through improved scheduling or if additional facilities are required to house anticipated enrollments. When additional facilities are being planned, utilization information can help to determine the number of rooms required and their proper station capacities. In the case study, the measures used in determining the levels of room and station utilization were: average weekly room periods, student station utilization rate, square feet per student station, and square feet per student contact hour.

An institution should establish utilization standards or goals for the purpose of evaluating the findings of its utilization studies. These goals should be derived in the light of the particular institution's curricular structure, instructional workloads, section sizes and overall policies. They should represent the optimum situation. Institutions differ in their educational policies, programs, etc., and the variation in utilization goals and rates between institutions across the nation implies that a variety of educational needs are being met. Consequently, comparisons of utilization standards and rates between institutions may have little validity.

In conducting a room utilization study, the area and station capacity data for an instructional room are merged with instructional data relative to classes or sections which are taught in that room. The required room information is contained in the master room inventory file. The required instructional data may be secured from student registration records or from a timetable expanded to include all necessary instructional information for each section. Having the two separate files provides the advantage of a mutual audit of the data. A file developed from student registration records which can supply the instructional data for utilization studies and serve as a base for projecting enrollments at the course level is most desirable.

Before the room inventory file and the departmental instructional file can be merged for generating a room utilization report, a reconciliation of the two records must be effected. Finally, a room utilization report and summary reports for the instructional space categories can be generated. Although a utilization study is primarily concerned with the levels of use of instructional facilities, the room inventory and instructional data files can be used for making other analyses: e.g., a comparison of room capacity distribution and section size distribution; a distribution of section meetings by hours of the day and days of the week; a time-day matrix showing the usage for each room, for rooms of a given range of capacities, or for rooms assigned to particular departments; and for doing instructional workload analyses.

A methodology for projecting space requirements must rely on projected student and staff data in forms relatable to space. Projected headcount enrollment is useful for projecting housing and dining facilities as well as general student service space. It may also serve as a basis for projecting some types of staff within an institution. Projected full time equivalent enrollment by student level may be used for projecting academic staff and certain administrative staff, and, at the graduate levels, for predicting research space needs. Student contact hours, projected at the course level and summed by department, are useful for projecting classroom and instructional laboratory space needs. In the case study, student enrollment data were available for a period of years and were used for identifying enrollment trends. Enrollment data for the year immediately preceding the projection period, however, were used as the base for the projections. The technique for deriving enrollment projections at the course level assumes that the course offerings and mix of students enrolled in a department's courses will remain relatively unchanged and that other factors which influence enrollment will remain the same. For the purposes of the case study, the staff in academic departments were related to FTE students by department and projected on the basis of student-staff ratios derived from base year relationships. The staff in administrative operations were also related to FTE students by division, college or institution--whichever was appropriate--and projected on the basis of the student-staff ratios derived from base year data.

In the conduct of this project a number of systems had to be developed; each one somewhat unique in terms of purpose, but an integral part of a total methodology for projecting institutional space requirements. The systems and their interrelationships are discussed in some detail in this report. The projection of space needs for a hypothetical department, with example figures and computations, is illustrated. The space needs figures for the base year were derived by multiplying the base year student and staff data by the appropriate space factors. They reflect the existing space needs of the department. When, after proper reconciliation, such figures are studied in relation to a department's inventory of existing space, proper adjustments can be made so that the assignment of space is made more equitable. The space requirements of a department for a given projection year can be determined by subtracting the space which the department expects to have in the projection year from its space needs for that year by space category. The expected space is derived by relating to the department's current inventory of existing space information contained in the record of approved construction and razings. A projection of departmental space requirements can be useful for facilities planning at the department level. To derive projected space requirements for an institution, the expected space by category is determined for the projection year by adding to the institution's inventory of existing space the space contained in the record of approved construction and subtracting from the inventory the space contained in the record of approved razings;

the institution's projected space needs are derived by summing the projected departmental space needs by category; and the institution's space requirements are determined by subtracting the expected space by category from the projected space needs by category for the projection year. The organization of the methodology for projecting an institution's physical facilities requirements is illustrated in the form of a detailed network in the text.

APPENDIXES

APPENDIX A

THE PHYSICAL FACILITIES INVENTORY

One of the elements essential to a methodology for predicting future physical facilities requirements is an inventory of the existing facilities and a knowledge of their use. Detailed and summary information relative to the location, function, capacity and assignment of rooms at a given point in time is requisite to assessing an institution's current space requirements and determining its space requirements at some point in the future. The information is also pertinent to the day-to-day management of institutional space and necessary for generating the ever-increasing number of physical facilities reports (both internal and external) which space personnel are called upon to make. The fundemental components, the procedural steps and the implementation of the physical facilities inventory system are discussed in this appendix.

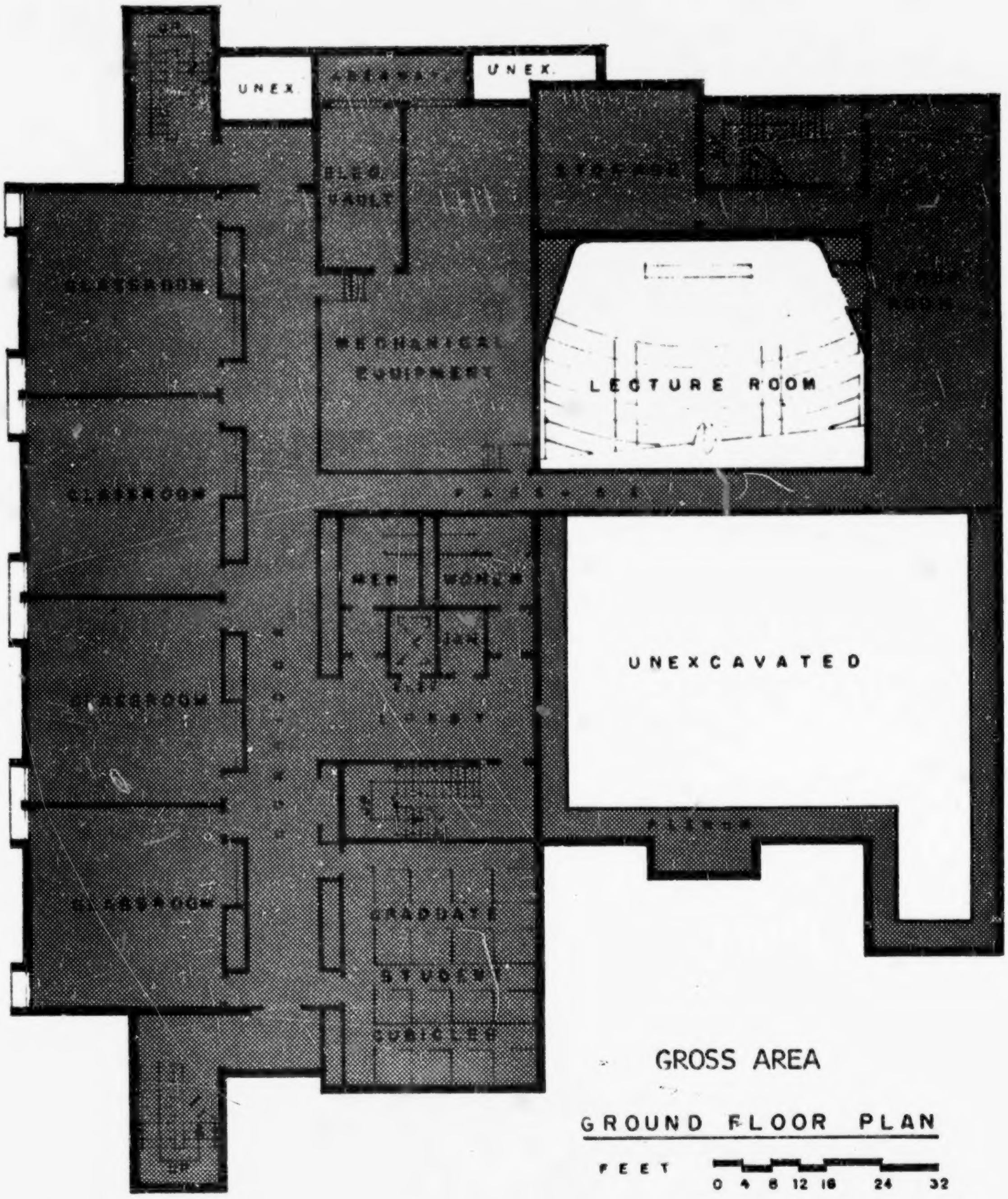
Criteria for Classifying, Defining and Measuring Building Areas

A logical beginning in devising a physical facilities inventory system is the development of criteria for classifying, defining and measuring the building areas. Several kinds of square footages need to be employed in expressing these areas; consequently, it is imperative that persons using the data have a common understanding of these elements when utilizing the data for space management purposes, planning future facilities, or making comparative space studies. The six basic area types are listed below.

1. Gross Area
2. Net Assignable Area
3. Custodial Area
4. Circulation Area
5. Mechanical Area
6. Construction Area

The following pages provide a set of definitions[1] to identify physical space in institutions of higher education. The six area types are adequate to describe the entire building and the function of each area. Except for any major remodeling of the building structure or layout, each area should remain constant for the life of the building.

[1] The definitions of building areas are based upon Classification of Building Areas, (1964), Publication 1235, National Academy of Sciences--National Research Council. This publication is also titled Technical Report No. 50, Federal Construction Council, by Task Group T-56. The illustrations of the area types were developed by the Office of Space Utilization at Michigan State University.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GROSS AREA

GROUND FLOOR PLAN

1. Gross Area

   a. Definition

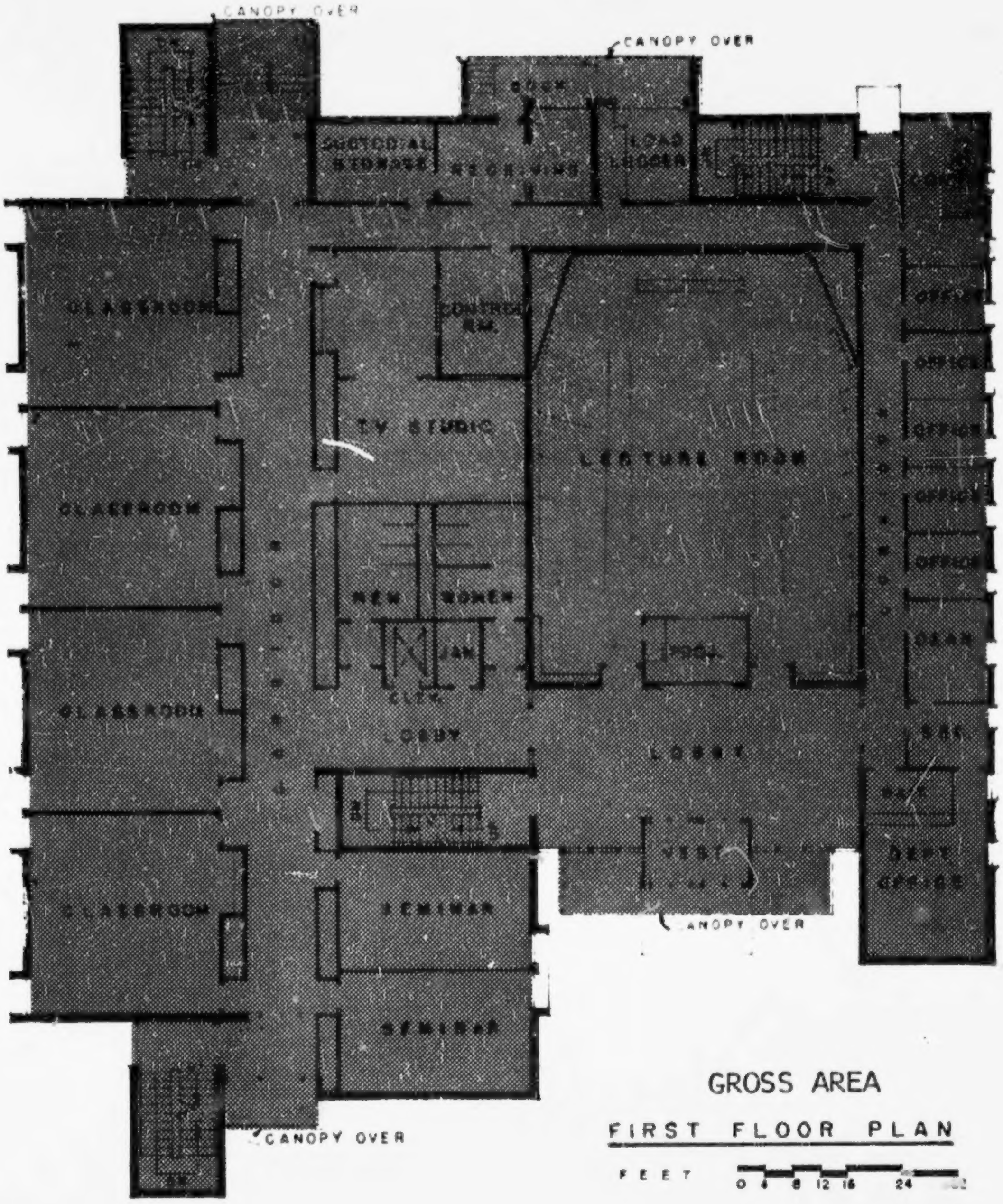
      "Gross Area" should be construed to mean the sum of the floor areas included within the outside faces of exterior walls for all stories, or areas, which have floor surfaces.

   b. Basis for Measurement

      Gross area should be computed by measuring from the outside face of exterior walls, disregarding cornices, pilasters, buttresses, etc., which extend beyond the wall face.

   c. Description

      In addition to ground - to top - story internal floored spaces obviously covered in "a" above, gross area should include basements (except unexcavated portions), attics, garages, enclosed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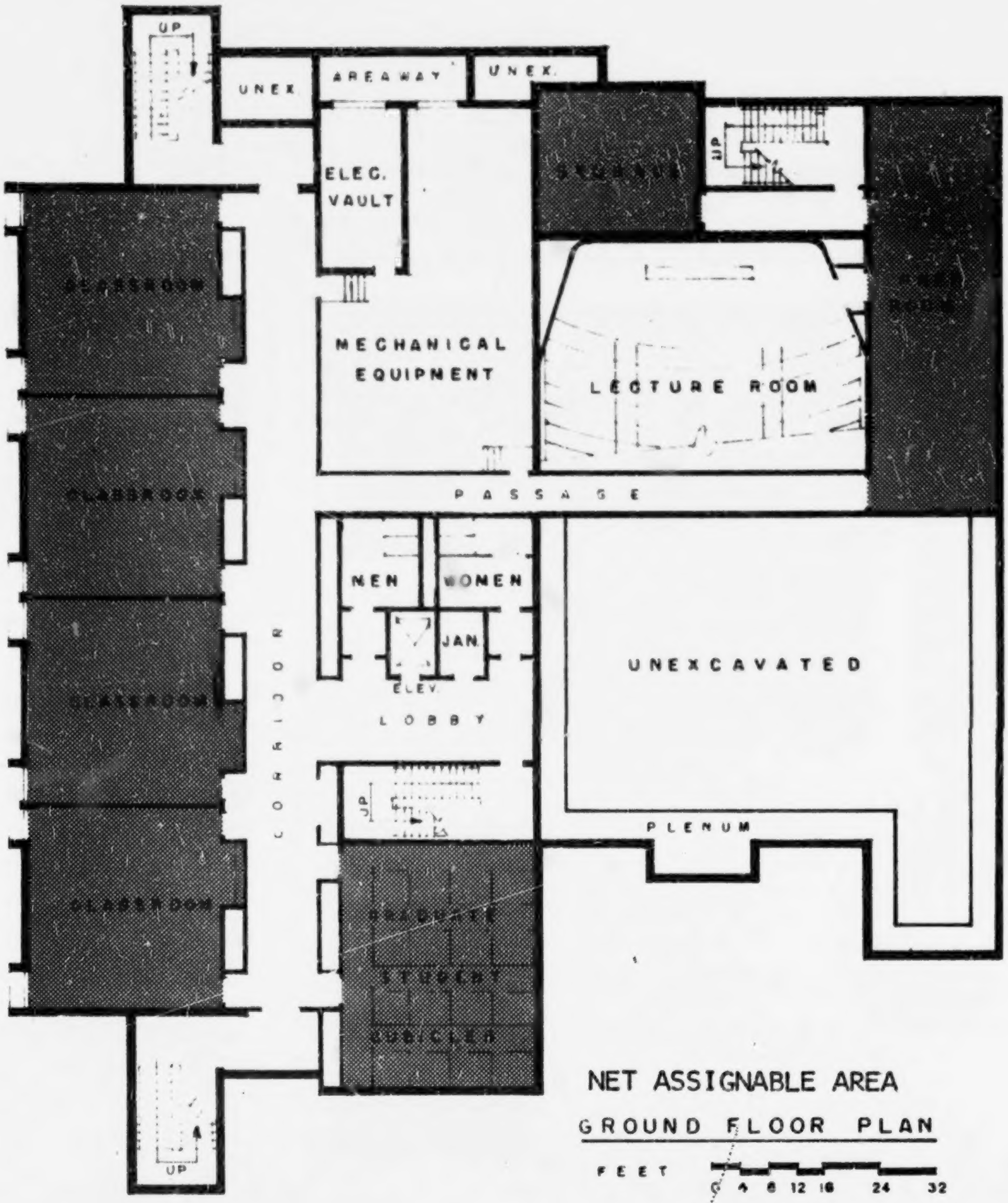
GROSS AREA

FIRST FLOOR PLAN

porches, penthouses and mechanical equipment floors, lobbies, mezzanines, all balconies--inside or outside--utilized for operational functions, and corridors, provided they are within the outside face lines of the building. Roofed loading or shipping platforms should be included whether within or outside the exterior face lines of the building.

d. Limitations

Open courts and light wells, or portions of upper floors eliminated by rooms or lobbies which rise above single-floor ceiling height, should not be included in the gross area, nor should unenclosed roofed-over areas or floored surfaces with less than 6 ft. 6 in. clear head-room be included unless they can properly be designated and used as either net assignable, mechanical, circulation, or custodial area.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NET ASSIGNABLE AREA

GROUND FLOOR PLAN

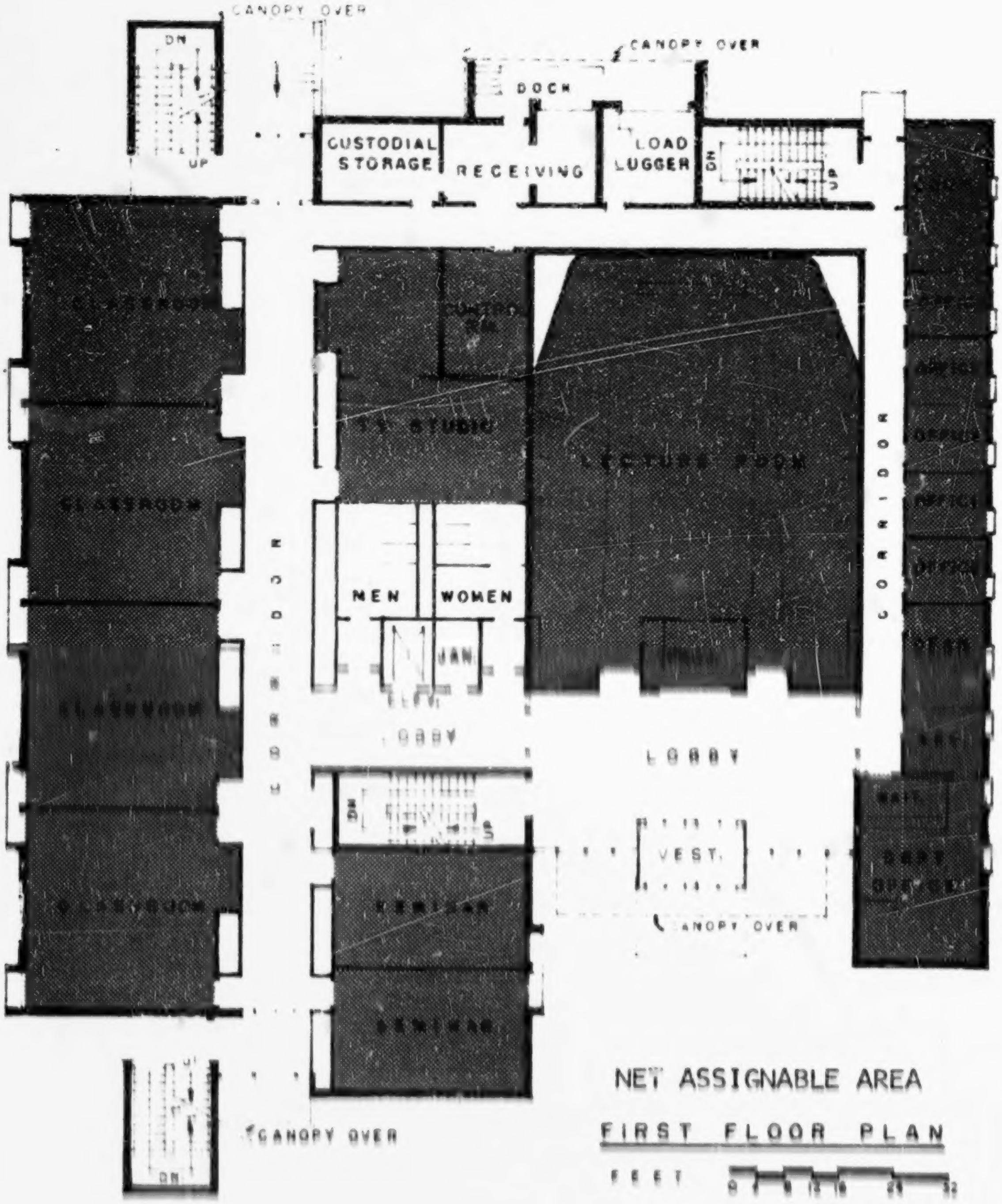
2. Net Assignable Area

   a. Definition

   "Net Assignable Area" should be construed to mean the sum of all areas on all floors of a building assigned to, or available for assignment to, an occupant, including every type of space functionally usable by an occupant (excepting those spaces elsewhere separately defined in area classifications 3, 4, and 5.

   b. Basis for Measurement

   All net assignable areas should be computed by measuring from the inside finish of permanent outer building walls, to the office side of corridors and/or to permanent partitions.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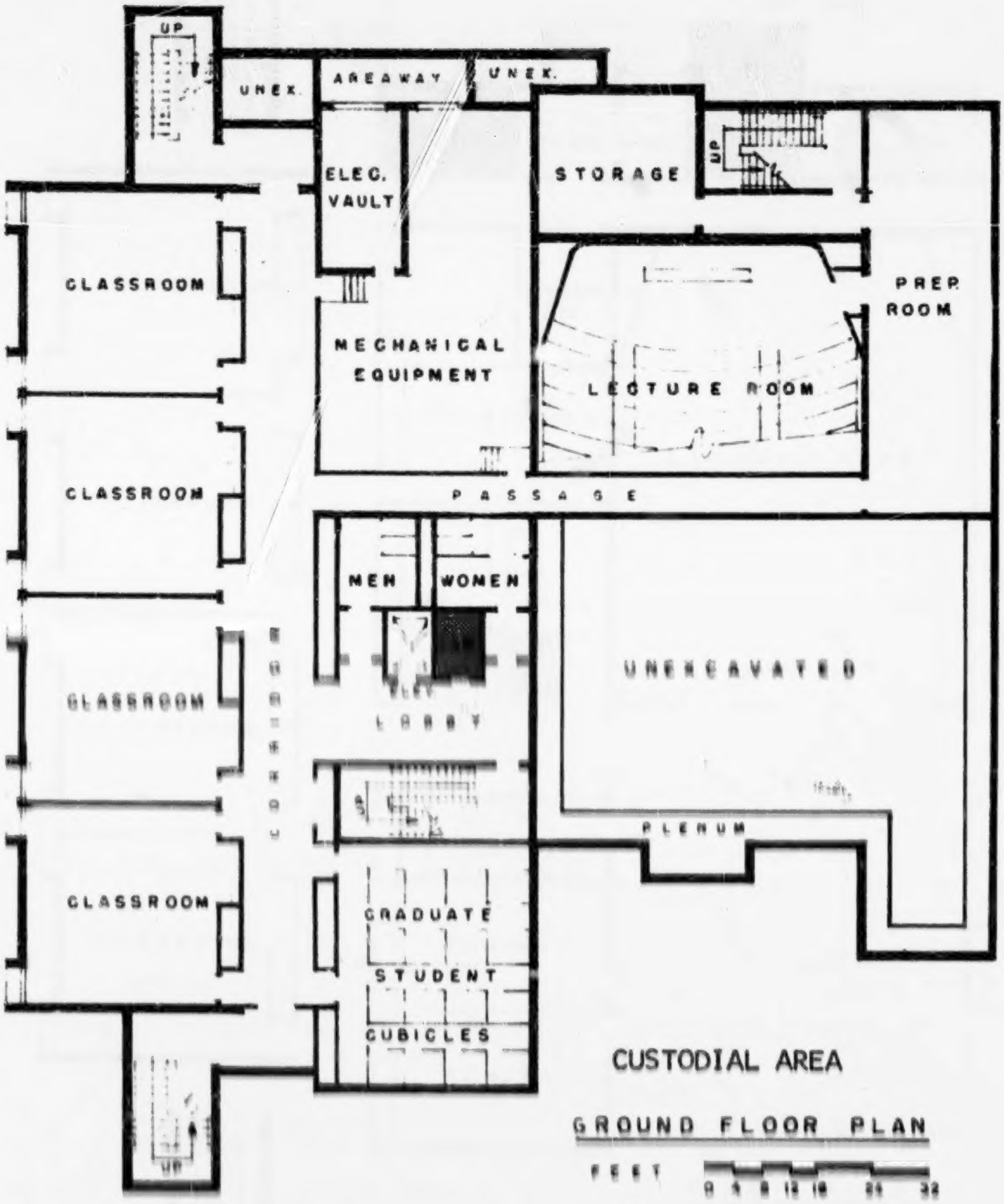
c. Description

Included should be space subdivisions for offices, classrooms, laboratories, seminar and conference rooms, libraries, file rooms, storage rooms, etc., including those for special purposes (e.g., auditoriums, cafeterias, TV studios, faculty and student locker and shower rooms, maintenance and research shops, garages), which can be put to useful purposes in accomplishment of the institution's mission.

d. Limitations

Deductions should not be made for columns and projections necessary to the building.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CUSTODIAL AREA

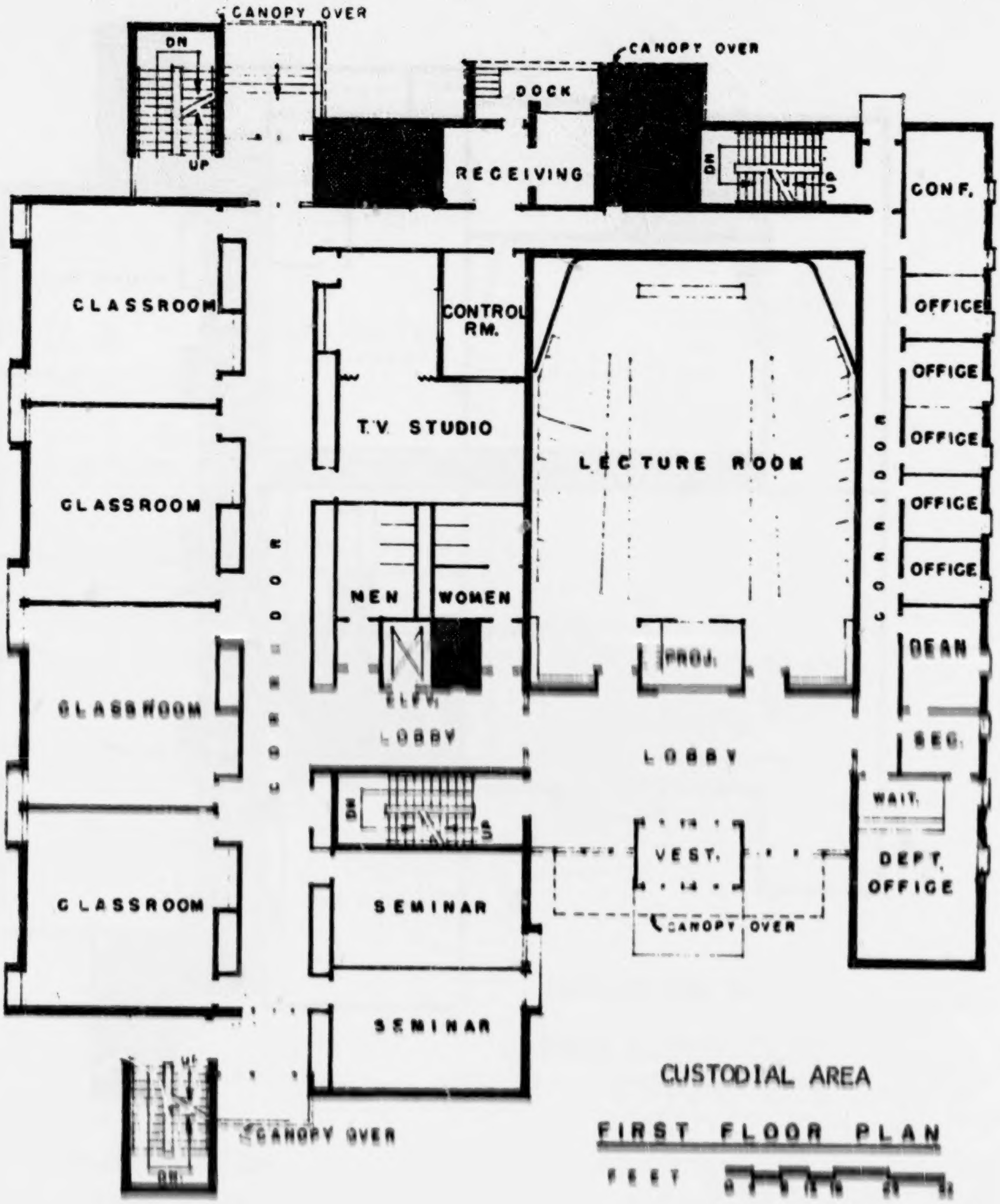
3. Custodial Area

a. Definition

"Custodial Area" should be construed to mean the sum of all areas on all floors of a building used for building protection, care, maintenance, and operation.

b. Basis for Measurement

These areas should be measured from the inside surfaces of enclosing walls.



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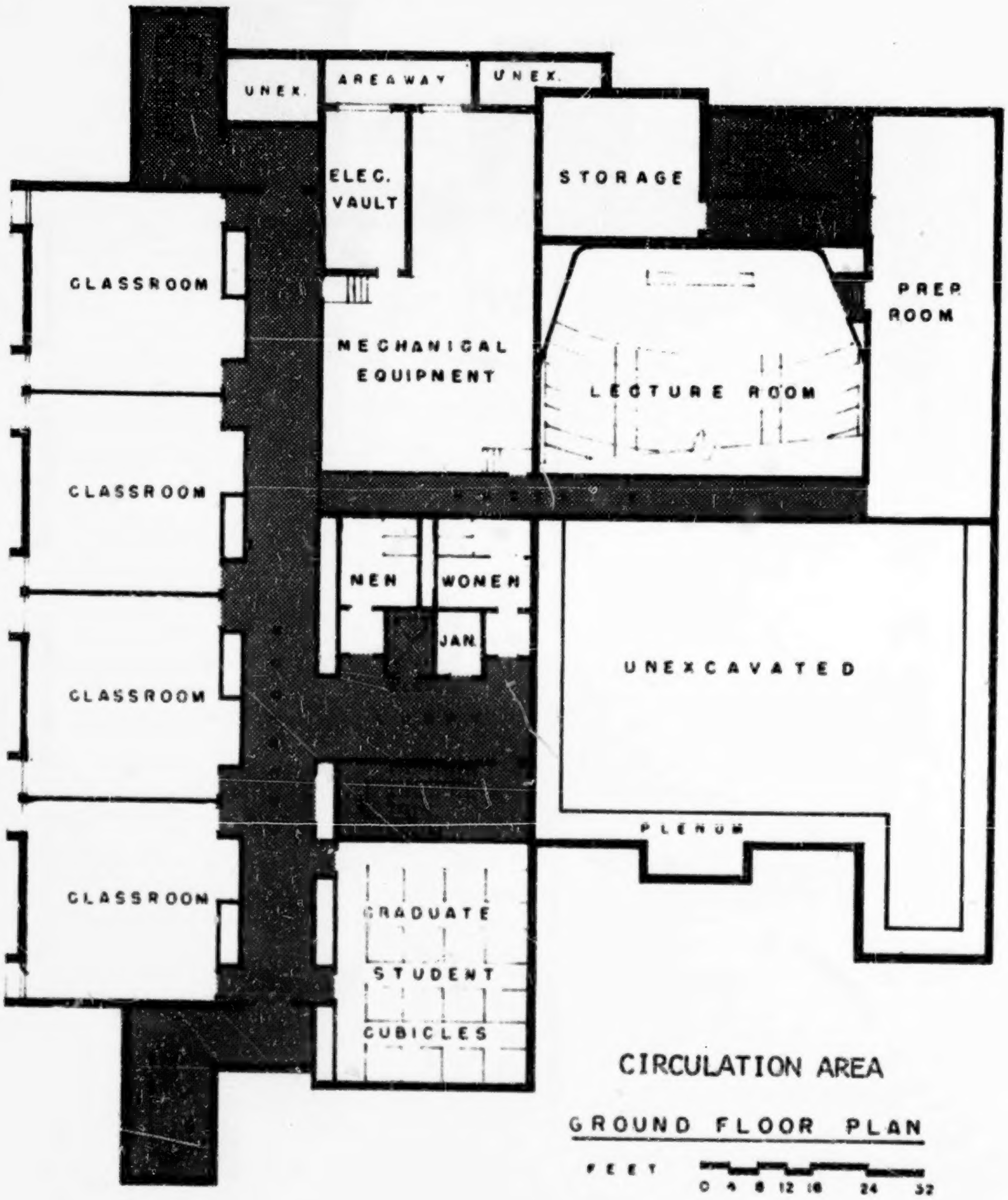
CUSTODIAL AREA

c. Description

Included should be such areas as custodial, locker rooms, janitors' closets, maintenance storerooms.

d. Limitations

Deductions should not be made for columns and projections necessary to the building.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CIRCULATION AREA

GROUND FLOOR PLAN

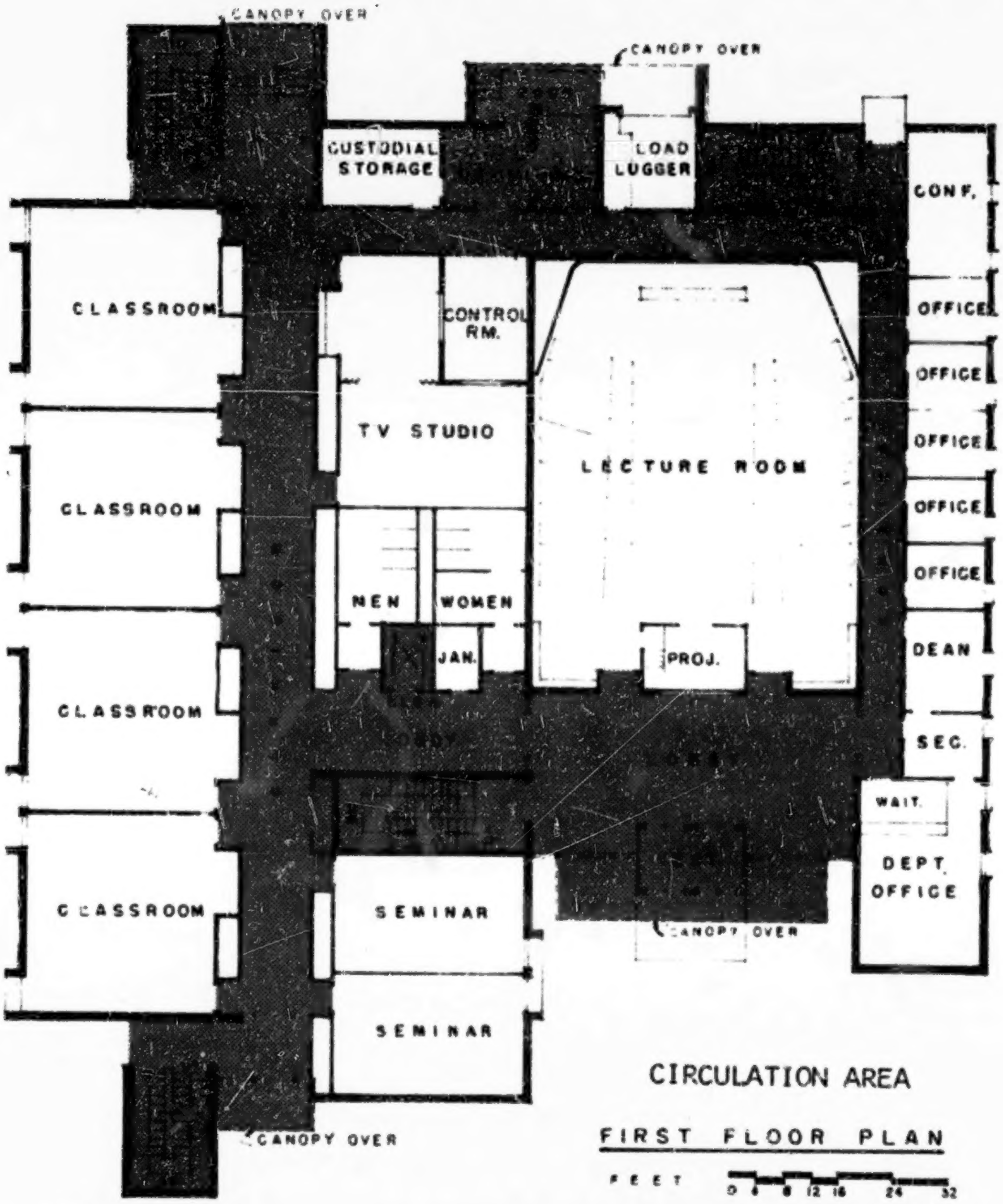
4. Circulation Area

a. Definition

"Circulation Area" should be construed to mean that portion of the gross area--whether or not enclosed by partitions--which is required for physical access to some subdivision of space.

b. Basis for Measurement

Circulation area should be computed by measuring from the inner faces of the walls or partitions which enclose horizontal spaces used for such purposes; or, when such spaces are not enclosed by walls or partitions, measurements should be taken from imaginary lines which conform as nearly as possible to the established circulation pattern of the building.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CIRCULATION AREA

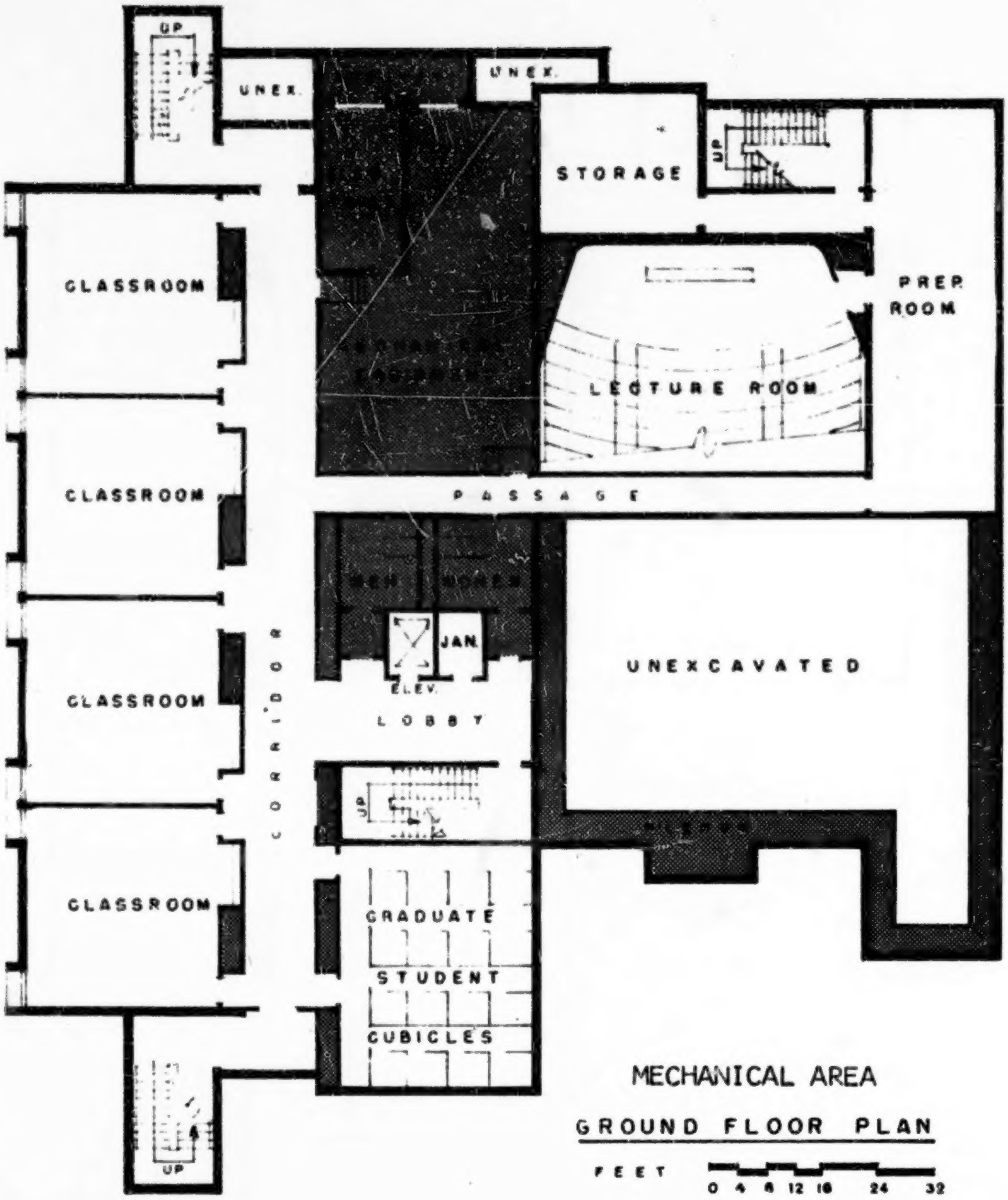
FIRST FLOOR PLAN

c. Description

Circulation areas should include, but not be limited to: corridors (access, public, service, also "phantom" for large unpartitioned areas); elevator shafts; escalators; fire towers or stairs; stairs and stair halls; loading platforms (except when required for operational reasons and, thus, includable in net assignable area); lobbies (elevator, entrance, public, also public vestibules); tunnels and bridges (not mechanical).

d. Limitations

When assuming corridor areas, only horizontal spaces required for general access should be included--not aisles which are normally used only for circulation within offices or other working areas. Deductions should not be made for columns and projections necessary to the building.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MECHANICAL AREA

GROUND FLOOR PLAN

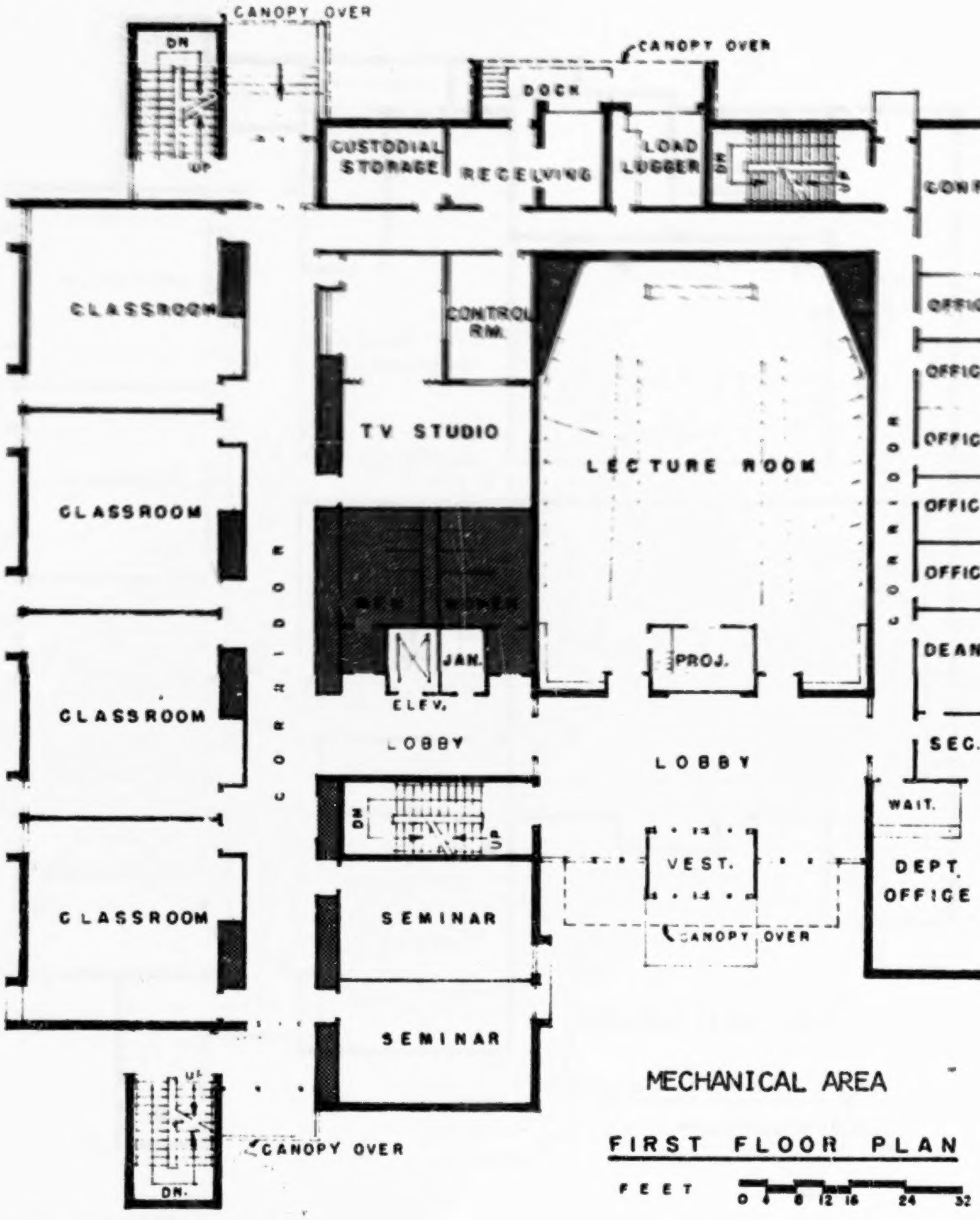
5. Mechanical Area

a. Definition

"Mechanical Area" should be construed to mean that portion of the gross area designed to house mechanical equipment, utility services, and non-private toilet facilities.

b. Basis for Measurement

Mechanical area should be computed by measuring from the inner faces of the walls, partitions, or screens which enclose such areas.



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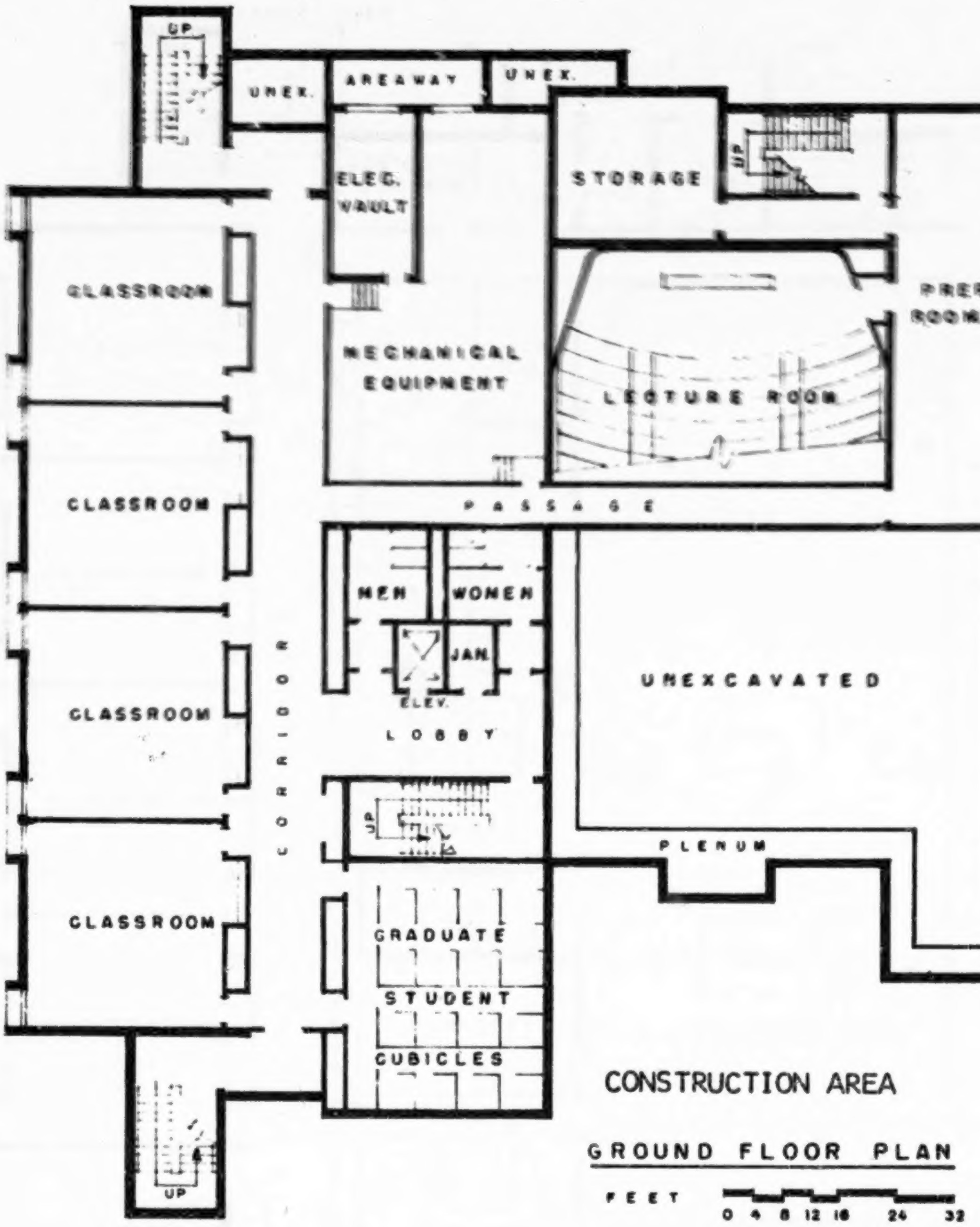
MECHANICAL AREA

c. Description

Mechanical area should include, but not be limited to: Air-duct shafts; boiler rooms; fixed mechanical and electrical equipment rooms; fuel rooms; mechanical service shafts; meter and communications closets; service chutes; stacks; and non-private toilet rooms (custodial and public).

d. Limitations

Deductions should not be made for columns and projections necessary to the building.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CONSTRUCTION AREA

6. Construction Area

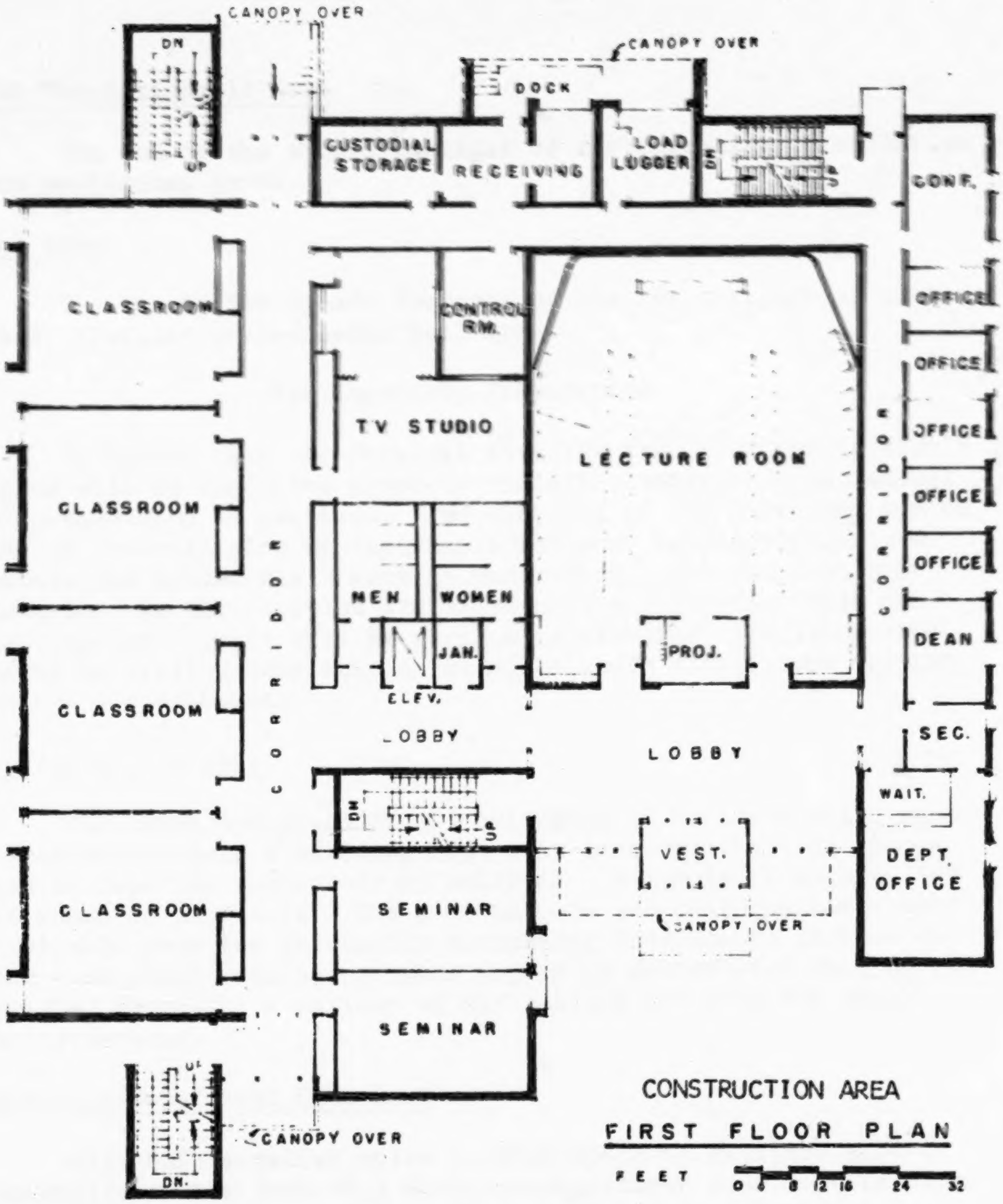
a. Definition

"Construction Area" should be construed to mean that portion of the gross area which cannot be put to use because of the presence of structural features of the building.

b. Basis for Measurement

Precise computation of construction area is not contemplated under these definitions--some construction features are included in the computation of other areas. However, total construction area should generally be determined by assuming it to be the residual area after the net assignable, circulation, custodial, and mechanical areas have been subtracted from the gross area.

1


CANOPY OVER
DN
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CANOPY OVER
DOCK
CUSTODIAL STORAGE
RECEIVING
LOAD LUGGER
DN
CONF.
CLASSROOM
CONTROL RM.
OFFICE
OFFICE
TV STUDIO
OFFICE
LECTURE ROOM
CLASSROOM
CORRIDOR
OFFICE
OFFICE
CORRIDOR
MEN
WOMEN
DEAN
JAN.
PROJ.
ELEV.
CLASSROOM
LOBBY
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SEC.
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DEPT. OFFICE
CLASSROOM
SEMINAR
CANOPY OVER
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UP
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FEET
0 4 8 12 16 24 32

CONSTRUCTION AREA

FIRST FLOOR PLAN

c. Description

Examples of areas normally classified as construction area are exterior walls, fire walls, permanent partitions, and unusable areas in attics, basements, or comparable portions of the building.

Net Non-Assignable Area

The sum of the square footages of the custodial, circulation and mechanical areas.

Net Area

The sum of the square footages of the net assignable, custodial, circulation and mechanical areas.

Pre-inventory Preparation

To insure that the physical inventorying of an institution's space will be conducted properly and efficiently, a great amount of preparation is required. The elements of the inventory system and the overall plan of implementation must be clearly defined before the actual field work is undertaken. The preparations described in this section are based on the assumption that an institution's space will be physically measured. Deriving room areas by scaling construction drawings would entail some changes in the preparations.

Building Code List

The codes and names of all buildings to be inventoried must be assembled into a building code list in order that all spaces can be reported accurately by building. A sample of such a list is shown on page A-15. The code numbers and building names were available from the University Accounting Code Manual for use in the case study. Building names appear in abbreviated form on the printed reports. A maximum of six letters was used for these abbreviations.

Division-Department Code List

All administrative units to whom space is assigned must be assembled in the form of a division-department code list in order that the institutional space can be reported by individual department and by division as a summation of its respective departments. For the case study, this list was also developed from the University Accounting Code Manual. A sample is shown on page A-16. It identifies each division by code and name as it does each department within a division. The department names were also abbreviated (maximum of five letters) and appear in such form on the printed reports shown as examples. For the purposes of this project, dummy division-department codes were established for classrooms since they are general assignment rooms and for general building areas such as circulation, mechanical and custodial areas since they are non-assignable spaces.

BLDG. CODE	BUILDING NAME	BLDG. ABBREV.
0088	Greenhouse & Potting House	GRN&PT
0090	Stock Pavilion	STOCK
0091	Farm Place 438 - Artist in Residence	438 FP
0092	Dairy Cattle Inst & Res Center	DCI&RC
0094	Veterinary Science Building New	VET SC
0099	Agricultural Engr Shops	AG E S
0102	Genetics Bldg	GENET
0103	Genetics Res Lab	GEN RS
0104	Farm Shop - Old Short Course Dining Hall	FARM S
0106	Babcock Hall	BABCK
0107	Horticulture Service Building	HORT S
0108	Carrot and Beet Labs	C&B LB
0110	Poultry Research Lab	POUL R
0111	High Energy Physics Laboratory	HE PHY
0112	Marsh Pump House	M PUMP
0113	University Avenue 1800	1800 U
0114	Russell Laboratories	RUSS L
0116	Intramural Warming House	WM HSE
0117	Physical Education Storage	PE STR
0119	Seed Building	SEED
0121	Farm Office	FRM OF
0122	Walnut Street Greenhouse	WAL GR
0123	Animal Research Laboratory-Abattoir Meat Lab	AN RES
0124	Service Dept Storage #2-Public Events	SDS #2
0128	Linden Drive 2151-Food Research Institute	2151 L
0129	University Ave 1610-Naval Armory	1610 U
0138	Poultry Disease Bldg 48 Newcastle	PD 48
0139	Poultry Disease Bldg 72 Newcastle	PD 72
0213	West Hill Farm Quonset No 4 NE	WHF Q4
0214	West Hill Farm Quonset No 5 SE	WHF Q5
0400	Education Building	EDUC
0401	Zoology Research Building	ZOO R
0402	Park Street N 600	600N P
0403	Hydraulics Lab Pump & Tank House	HYDRL
0404	Observatory Drive 970	970 OB
0405	Radio Hall	RADIO
0407	Mechanical Engineering Building	M ENGR
0408	Engineering Building	ENGR
0430	Law Building	LAW
0465	Virus & Fur Research Lab	V&F R
0470	Psychology Building	PSYCH
0472	Service Dept Storage #3-Grounds	SDS #3
0474	Fleet & Truck Service-1006 College Ct	FL&TRK

DIV CODE	DEPT CODE	DIVISION OR DEPARTMENT NAME	DEPT ABBREV
45		LAW SCHOOL	
	1000	Law School	LAW
48		LETTERS & SCIENCE	
	0200	Administration	ADMIN
	0400	Acad Year Institute - NSF	AYI
	0500	Adult Speech & Hearing	A S&H
	0600	African Languages & Literature	A L&L
	0700	Anthropology	ANTH
	0900	Art History	ART H
	1100	Astronomy	ASTR
	1200	Astronomy Space Astronomy Lab	S A L
	1300	Botany	BOT
	1500	Chemistry	CHEM
	1600	Chemistry Lab - Theoretical	C L-T
	1800	Chinese	CHIN
	1900	Classics	CLAS
	2000	Comparative Literature	C LIT
	2100	Computer Sciences	C SCI
	2200	Economics	ECON
	2400	English	ENG
	2600	French & Italian	FR&I
	2800	General Interdept	GEN I
	2900	Geography	GEOG
	3200	Geology	GEOL
	3300	Geophysics-Polar Res	G-P R
	3500	German	GER
	3700	Hebrew & Semitic Studies	H&S S
	3800	History	HIST
	3900	History of Science	H SCI
	4100	Humanities-Institute Research	H-I R
	4200	Ibero-Amer Area Studies	I-A S
	4300	Indian Language-Area Center	IND L
	4400	Indian Studies	IND S
	4500	Industrial Relations Research Center	IRRC
	4700	Integrated Liberal Study	I L A
	4900	Journalism	JOURN
	5100	Library School	LIB S
	5200	Linguistics	LING
	5400	Mathematics	MATH

Space Classification System

A logical system must be devised for classifying the spaces which are to be inventoried. In setting up such a system, the institution's particular campus planning and development needs, space management needs, business managment needs, and reporting needs must be carefully studied to insure that the inventory data will be collected, processed and finally reported in such a manner as to meet all needs. The space classification system developed in the case study is presented on Page A-18. It contains the space categories by which all of the institutional space was reported and provides for the further identification of rooms in the inventory by room type. A code is assigned to each category and to each room type for machine data processing. Category names and room types are placed in computer core storage in an abbreviated form with a maximum of eight letters, respectively. The abbreviations appear on the printed reports.

Space Category Definitions: In order that the spaces inventoried can be classified in a correct and consistent manner by any number of persons working with the inventory, it is essential that the space categories be precisely defined. The space categories and definitions developed for the case study are shown below.

1. Classroom -- rooms providing seating with writing surfaces which are available for the general assignment of scheduled instruction; e.g., classrooms, lecture halls, lecture-demonstration rooms, seminar rooms, and the prorated seating areas of auditoria and theaters used for scheduled class meetings.

2. Classroom Service -- ancillary rooms devoted to the storage or preparation of materials used in conjunction with classroom instruction; e.g., projection booths, coat rooms, and lecture-demonstration prep rooms.

3. Instructional Laboratory -- rooms equipped for student participation in experimental study, practice, testing and analysis which are generally limited in their assignment for scheduled instruction to a single department or unit, and in which the number of stations CAN be based upon a specific amount of work area per student. This category includes most wet laboratories, dry laboratories, language laboratories, art studios, drafting rooms, group practice rooms, etc., but excludes physical education facilities such as gymnasia, swimming pools, etc.

SPACE CLASSIFICATION SYSTEM

CATEGORY CODE	CATEGORY
010	Classroom
011	Classroom Service
020	Instructional Laboratory
021	Instructional Special Laboratory
022	Instructional Laboratory Service
030	Administrative Office
031	Administrative Office Service
040	Academic Office
041	Academic Office Service
050	Physical Education
051	Physical Education Service
060	Library Office
061	Library Office Service
062	Library Study and Stack
063	Library Study and Stack Service
070	Laboratory School and Service
080	Auditorium
081	Auditorium Service
100	Research Office
101	Research Office Service
102	Research Laboratory
103	Research Special Laboratory
104	Research Laboratory Service
201	Ext and Pub Service Office
202	Ext and Pub Service Office Service
203	Ext and Pub Service Operation
300	Auxiliary Enterprise
400	Physical Plant
600	Warehouse
800	Inactive
900	Custodial
901	Circulation
902	Mechanical
903	Rest Room
904	Construction

ROOM TYPE CODE	ROOM TYPE
002	Seminar
004	Classroom (0-85)
006	Lecture (Over 85)
020	Wet Laboratory
022	Dry Laboratory
024	Language Laboratory
026	Drafting Room
028	Computation Room
030	Music or Art Studio
032	Group Practice Room
100	Greenhouse
102	Drill Area
104	Arena
106	Home Management House
108	Court Room
160	Computer Equipment Room
162	Machine Records Room
180	Sound Proof Room
200	Clinic
202	Observation Room
204	Testing Room
206	X-Ray Room
208	Autopsy Room
210	Animal Experiment Room
212	Animal Surgery Room
214	Animal Stall
216	Animal Retention Room
218	Aquarium
220	Controlled Environment Rm
222	Incubator Room
224	Rearing Room
226	Cold Room
228	Plant Growth Chamber
230	Culture Room
232	Transfer Room

ROOM TYPE CODE	ROOM TYPE
260	Projection Booth
262	Film Viewing Room
264	Dark Room
266	Photo Studio
268	Broadcasting or Recording Studio
270	Announcer's Booth
280	Listening Room
282	Individual Practice Room
300	Equipment and Materials Distribution Room
302	Preparation Room
304	Centrifuge Room
306	Oven, Drying or Dessicator Rm
308	Balance Room
310	Instrument Room
312	Lab Equipment Room
314	Lab Apparatus Cleaning Room
316	Autoclave or Sterilizing Room
318	Cage Cleaning Room
320	Isotope Room
322	Control Room
324	Sound, Air or Light Lock
326	Refrigerated or Freezer Storage
328	Water Preparation and Storage
330	Liquid Gas Storage
400	Shower Room
402	Locker Room
404	Dressing Room
440	Gym
442	Dance Studio
444	Indoor Track
446	Athletic Activity Room
448	Training Room
450	Swimming Pool
452	Towel and Equipment Room
454	Coach's Room
456	First Aid Room
500	Work Room
502	Storage Room
504	Vault
506	Closet or Coat Room
520	Faculty Office
522	Civil Service Office
524	Graduate Assistant Office
526	Office-Studio
540	Conference Room
542	Interview Room
544	Counseling Room
560	Reception Room
562	Duplicating Room
564	File Room
566	Mail Room
568	Office Commons
580	Washroom
582	Private Toilet
600	Auditorium
602	Theater
604	Stage
620	Study Room
640	Reading or Reference Room
642	Faculty Study
644	Carrel
646	Library Stacks
648	Book Circulation
650	Archives
652	Other Library
680	Collection or Specimen Rm
682	Museum or Gallery
700	Ticket Booth
702	Check Room
704	Spectator Seating
720	Cashier's Booth
740	Dining Room
742	Cafeteria
744	Serving Line
746	Snack Bar
748	Kitchen
750	Pantry
752	Dishwashing Room
760	Student Organization Room
780	Lounge
782	Merchandising Room
784	Recreation Room
786	Guest Room
800	Shop
820	Garage
850	Materials Shipping or Receiving Room
852	Janitor's Room
854	Incinerator Room
856	Trash Room
900	Stairwell
902	Elevator
904	Dumbwaiter
906	Corridor
908	Vestibule
920	Mechanical Equipment Room
922	Elevator Equipment Room
924	Electrical Equipment Room
926	Compressor Room
928	Fan Room
930	Boiler Room
932	Pipe Space
940	Switchboard Room
942	Telephone Equipment Room
944	Telephone Booth
946	Teletype Room
960	Public Rest Room-Men
962	Public Rest Room-Women
980	Remodel
982	Unassigned
990	Non-usable

4. Instructional Special Laboratory -- rooms other than physical education areas, equipped for student participation in experimental study, practice, testing, and analysis, which are limited in their assignment for scheduled instruction to a single department or unit, but in which the number of stations CANNOT be based upon a specific amount of work area per student. This category includes greenhouses, animal experiment rooms, arenas, home management houses, drill areas, etc., but excludes physical education facilities such as gymnasia, swimming pools, etc.

5. Instructional Laboratory Service -- spaces for the preparation, distribution or storage of materials or for the housing of specialized equipment used in support of instruction in laboratories or special laboratories; e.g., equipment and materials distribution rooms, preparation rooms, balance rooms, lab apparatus cleaning rooms and refrigerated storage rooms.

6. Administrative Office -- rooms or groups of rooms containing office equipment with assigned work stations at a desk or table where administrative personnel carry on the bulk of their work. (Administrative personnel should be interpreted to include the entire staff of administrative units down to and including Deans.)

7. Administrative Office Service -- rooms or groups of rooms generally containing office equipment which have NO specifically assigned work stations, but which are used by administrative personnel in support of their office activities; e.g., duplicating rooms, file rooms, vaults, reception rooms, interview rooms, conference rooms, office commons and private toilets or washrooms.

8. Academic Office -- rooms or groups of rooms containing office equipment with assigned work stations at a desk or table where academic personnel carry on the bulk of their work other than the meeting of classes. This category includes faculty offices, civil service offices, and graduate assistant offices used primarily for work related to instruction; it excludes offices assigned to administrative, research, library, extension, physical plant, or auxiliary enterprise personnel.

9. Academic Office Service -- rooms or groups of rooms generally containing office equipment which have NO specifically assigned work stations, but which are used by academic personnel in support of their office activities; e.g., duplicating rooms, file rooms, vaults, reception rooms, interview rooms, conference rooms, office commons and private toilets or washrooms.

10. Physical Education -- rooms or areas assigned to the physical education departments which are used for scheduled instruction in athletic activities, free-time athletic activities or intramural sports. This category includes gymnasia, swimming pools, athletic activity rooms, indoor tracks, etc., but excludes similar areas assigned to intercollegiate athletics.

11. Physical Education Service -- rooms or areas assigned to the physical education departments where people ready themselves before or after athletic activities. These are spaces used for the storage and maintenance of athletic equipment and materials or other spaces which support physical education activity areas. The category includes shower rooms, locker rooms, towel and equipment rooms, spectator seating areas which are used to accommodate students in physical education, etc., but excludes similar areas used for intercollegiate athletics.

12. Library Office -- rooms or groups of rooms containing office equipment that have assigned work stations at a desk or table where library personnel carry on the bulk of their office activities.

13. Library Office Service -- rooms or groups of rooms generally containing office equipment which have NO specifically assigned work stations, but which are used by library personnel in support of their office activities; e.g., duplicating rooms, file rooms, vaults, reception rooms, conference rooms, office commons, private toilets or washrooms.

14. Library Study and Stack -- spaces used by students and staff which are devoted to individual study or to the storage of books and other instructional materials for use by individuals. This category contains general library facilities and departmental libraries which are

supervised by at least half time librarians. It includes reading rooms, study rooms, carrels, listening rooms, library stacks, rare book collection rooms, film and record rooms, etc., but excludes rooms used for instruction in library science or other disciplines.

15. Library Study and Stack Service -- rooms or areas which directly support library use; e.g., card catalog rooms, circulation desks, acquisitions rooms, document reproduction rooms, archives, etc. Library offices and office service rooms are excluded from this category.

16. Laboratory School and Service -- all rooms and spaces assigned to the laboratory school functions of teaching and research. Rooms used for the purpose of collegiate instruction are excluded from this category.

17. Auditorium -- rooms possessing a stage, audience seating and other facilities for the purpose of presenting dramatic plays, concerts and similar events. This category excludes auditoria and theaters or portions of these facilities which may be used for scheduled instruction.

18. Auditorium Service -- rooms or areas used in support of auditorium or theater activities; e.g., dressing rooms, projection booths, scenery rooms, etc.

19. Research Office -- rooms or groups of rooms containing office type equipment that have assigned work stations at a desk or table where research personnel carry on office activities. Office spaces within laboratories which are assigned to research personnel are included in this category.

20. Research Office Service -- rooms or groups of rooms generally containing office equipment that have NO specifically assigned work stations but which are used by research personnel in direct support of their office activities. This category includes duplicating rooms, interview rooms, conference rooms, office commons, and private toilets or washrooms.

21. Research Laboratory -- rooms equipped for experimental study, testing and analysis in which specific work stations are definable and which are used by graduate students outside of scheduled instruction, academic personnel performing research, personnel of research bureaus

or experiment stations, and staff performing research supported by external funds.

22. Special Laboratory-Research -- rooms equipped for experimental study, testing and analysis in which specific work stations are NOT definable, but which are used by graduate students outside of scheduled instruction, academic personnel performing research, personnel of research bureaus or experiment stations and staff performing research supported by external funds; e.g., greenhouses, animal retention rooms, nuclear reactors, particle accelerators, etc.

23. Research Laboratory Service -- spaces for the preparation, distribution, or storage of materials or for the housing of specialized equipment used in support of research laboratories or special laboratories; e.g., preparation rooms, transfer rooms, balance rooms, lab apparatus cleaning rooms, instrument rooms, etc.

24. Extension and Public Service Office -- rooms or groups of rooms containing office equipment which have assigned work stations at a desk or table where extension and public service personnel carry on the bulk of their office activities.

25. Extension and Public Service Office Service -- rooms or groups of rooms generally containing office equipment which have NO specifically assigned work stations, but which are used by extension and public service personnel in support of their office activities; e.g., duplicating rooms, file rooms, vaults, reception rooms, conference rooms, office commons, and private toilets or washrooms.

26. Extension and Public Service Operation -- rooms other than those classifiable as office or office service which are assigned to programs such as correspondence instruction, public lectures, institutes and conferences, field services, museums and exhibition, and radio and television, which are directed at general public adult education and public service.

27. Auxiliary Enterprise -- all spaces assigned to student union and intercollegiate athletics as well as other rooms or areas devoted or related to revenue-producing operations; e.g., vending machine rooms, cafeterias, stores, telephone booths, and student and staff lounges.

28. Physical Plant -- rooms or areas assigned to the physical plant departments for general institutional plant maintenance and operation, and offices and office service areas assigned to these departments. This category includes civil service offices, office service areas, service shops, garages, central heating plants, etc., but excludes similar areas serving an individual building.

29. Warehouse -- rooms or areas used for the storage of materials and equipment for which there is only an occassional demand. Such spaces could be physically separated from any department and maintained centrally and may have sub-standard heating, lighting and/or headroom. This category excludes spaces which are used to store materials and supplies that are in frequent demand; e.g., rooms used for the storage of office supplies.

30. Inactive -- rooms or spaces which are not in use due to one of the following reasons: new construction or alteration, temporarily unassigned; or non-usable, but expected to be returned to active use if remodeled.

31. Custodial -- rooms or spaces used for the protection, care, maintenance and operation of an individual building; e.g., janitor's rooms, incinerator rooms, trash rooms, shops, locker rooms, and showers.

32. Circulation -- rooms or spaces which are that portion of gross area required for physical access of personnel and equipment to some subdivision of space. This category includes corridors, elevators, escalators, stairs, loading platforms, lobbies, vestibules and non-mechanical tunnels and bridges, etc.; but excludes internal corridors which are normally used only for circulation within offices and working areas.

33. Mechanical -- rooms or spaces which are that portion of the gross area designed to house mechanical equipment and utility service for an individual building; e.g., mechanical equipment rooms, elevator equipment rooms, electrical equipment rooms, compressor rooms, etc.

34. Restroom -- men's or women's public toilets and rest areas adjacent to women's toilets.

35. Construction -- rooms or spaces which are that portion of the gross area which cannot be put to use because of the presence of structural features of the building. This category includes non-usable spaces which are not expected to be returned to active use.

Room Type: The list of room types (the second element of the space classification system) was developed on the premise that each room would be described by the room type appearing in the list which most appropriately described its use. Inasmuch as the wordage is descriptive of the type, it was not considered necessary to define these. However, it may be helpful to show the room types which commonly occur in conjunction with each space category. Typical relationships found in the case study are set forth below, but should not be considered all inclusive since other combinations may occur.

- 010 CLASS RM
  - 002 SEMINAR
  - 004 CLASS RM
  - 006 LECTURE
  - 600 AUD

- 011 CL RM SR
  - 260 PROJ BTH
  - 302 PREP RM
  - 502 STORAGE
  - 620 STUDY RM

- 020 INST LAB
  - 020 WET LAB
  - 022 DRY LAB
  - 024 LANG LAB
  - 026 DRAFTING
  - 028 COMPT RM
  - 030 STUDIO
  - 032 GRP PRAC
  - 202 OBSERV

- 021 IN SP LB
  - 100 GREENHSE
  - 102 DRILL
  - 104 ARENA
  - 106 HOME MAN
  - 160 COMPUTER
  - 180 SOUND PR
  - 200 CLINIC
  - 202 OBSERV
  - 204 TESTING
  - 206 X-RAY
  - 208 AUTOPSY
  - 210 AN EXP
  - 212 AN SURG
  - 214 AN STALL
  - 216 AN RET
  - 220 CONT ENV
  - 228 PLANT GR
  - 230 CULTURE
  - 232 TRANSFER
  - 268 BDCST RC
  - 270 ANNOUNCE
  - 946 TELETYPE

022 I LAB SR

162 MACH REC
206 X-RAY
214 AN STALL
216 AN RET
218 AQUARIUM
220 CONT ENV
222 INCUB RM
224 REARING RM
226 COLD RM
228 PLANT GR
230 CULTURE
232 TRANSFER
264 DARK RM
266 PHOTO ST
280 LISTENG
282 IND PRAC
300 DISTRB
302 PREP RM
304 CENTRIF
306 OVEN RM
308 BALANCE
310 INSTR RM
312 LAB EQIP
314 AP CLEAN
316 STERL RM
318 CAGE CL
320 ISOTOPE
322 CONTROL
324 SAL LOCK
326 REFRIG S
328 WATER
330 L&G STOR
400 SHOWER
402 LOCKER
404 DRESS RM
500 WORK RM
502 STORAGE
504 VAULT
564 FILE RM
580 WASHROOM
582 TOILET
620 STUDY RM
640 READ REF
800 SHOP
854 INCIN RM
920 MECH EQ
924 ELEC EQ

030 ADMN OFF

520 F OFFICE
522 C OFFICE
524 G OFFICE
526 OFF ST

031 AD OF SR

026 DRAFTING
028 COMPT RM
160 COMPUTER
162 MACH REC
264 DARK RM
400 SHOWER
402 LOCKER
500 WORK RM
502 STORAGE
504 VAULT
506 CLOSET
540 CONF RM
542 INTRVIEW
544 COUNS RM
560 RECEPTN
562 DUPLICAT
564 FILE RM
566 MAIL RM
568 COMMONS
580 WASHROOM
582 TOILET
940 SWITCHBD

040 AC OFF

(Same as ADMN OFF)

041 AC OF SER

(Same as AD OF SR)

- 050 PHY ED
  - 440 GYM
  - 442 DANCE ST
  - 444 INDR TRK
  - 446 ATH ACT
  - 448 TRAINING RM
  - 450 POOL

- 051 P E SERV
  - 400 SHOWER
  - 402 LOCKER
  - 403 DRESS RM
  - 448 TRAINING
  - 452 TOWEL RM
  - 456 FRST AID
  - 502 STORAGE

- 060 LIBR OFF
(Same as ADMN OFF)
(

- 061 L OFF SR
(Same as AD OF SR)

- 062 LIBR S&S
  - 620 STUDY RM
  - 640 READ REF
  - 642 F STUDY
  - 644 CARREL
  - 646 STACK

- 063 L S&S SR
  - 500 WORK ROOM
  - 504 VAULT
  - 648 BOOK CIR
  - 650 ARCHIVE
  - 652 OTHR LIB
  - 680 COLLECTION

- 070 LAB SCHL
(All Room Types)

- 080 AUD
  - 600 AUD
  - 602 THEATER
  - 604 STAGE

- 081 AUD SERV
  - 260 PROJ BTH
  - 404 DRESS RM
  - 500 WORK RM
  - 502 STORAGE
  - 560 RECEPTN

- 100 RES OFF
(Same as ADMN,OFF)

- 101 R OFF SR
(Same as AD OF SR)

- 102 RES LAB
(Same as INST LAB)

- 103 R SP LAB
(Same ad I SP LAB)

- 104 R LAB SR
(Same as I LAB SR)

- 201 EXT OFF
(Same as ADMN OFF)

- 202 EX OF SR
(Same as AD OF SR)

203 EXT OPER

020	WET LAB
022	DRY LAB
026	DRAFTING
028	COMPT RM
160	COMPUTER
162	MACH REC
180	SOUND PR
202	OBSERV
260	PROJ BTH
262	FLM VIEW
264	DARK RM
266	PHOTO ST
268	BDCST RC
270	ANNOUNCE
302	PREP RM
306	OVEN RM
322	CONTROL
324	SAL LOCK
400	SHOWER
402	LOCKER
404	DRESS RM
500	WORK RM
502	STORAGE
504	VAULT
506	CLOSET
620	STUDY RM
680	COLLECTN
682	MUSEUM
800	SHOP
920	MECH EQ
924	ELEC EQ
926	COMPR RM
928	FAN RM
946	TELETYPE

300 AUX ENTR

030	STUDIO
262	FLM VIEW
326	REFRIG S
400	SHOWER
402	LOCKER
404	DRESS RM
440	GYM
444	INDR TRK
446	ATH ACT
448	TRAINING
450	POOL
452	TOWEL RM
454	COACH
456	FRST AID
500	WORK RM
502	STORAGE
504	VAULT
520	F OFFICE
522	C OFFICE
524	G OFFICE
526	OFF ST
540	CONF
560	RECEPTN
562	DUPLIC
564	FILE RM
566	MAIL RM
568	COMMONS
582	TOILET
640	READ REF
700	TICKET
702	CHECK RM
704	SEATING
720	CASHIER
740	DINING
742	CAFE
744	SER LINE
746	SNACK B
748	KITCHEN
750	PANTRY
752	DISHWASH
760	STU ORGZ
780	LOUNGE
782	MDSE RM
784	REC RM
786	GUEST RM
800	SHOP
944	TEL BTH

400 PHYS PLT
100 GREENHSE
310 INSTR RM
328 WATER
330 L&G STOR
400 SHOWER
402 LOCKER
500 WORK RM
502 STORAGE
504 VAULT
506 CLOSET
522 C OFFICE
540 CONF RM
542 INTRVIEW
560 RECEPTN
564 FILE RM
566 MAIL RM
568 COMMONS
580 WASHROOM
582 TOILET
800 SHOP
820 GARAGE
920 MECH EQ
924 ELEC EQ
926 COMPR RM
928 FAN RM
930 BOILER

600 WHSE
502 STORAGE

800 INACTIVE

980 REMODEL
982 UNASSIGN
990 NON-USAB

900 CUSTOD
400 SHOWER
402 LOCKER
850 MTRL S&R
852 JANITOR
854 INCIN RM
856 TRASH

901 CIRCUL
900 STAIR
902 ELEVATOR
904 D WAITER
906 CORRIDOR
908 VESTIB

902 MECH
920 MECH EQ
922 ELEV EQ
924 ELEC EQ
926 COMPR RM
928 FAN RM
930 BOILER
932 PIPE SP
942 TEL EQ

903 REST RM
960 RST RM M
962 RST RM W

904 CONSTR
990 NON-USAB

Building Plans

The total conduct of the physical facilities inventory is seriously impaired when building plans are unavailable. The documents serve two major purposes: firstly, they afford the survey personnel opportunity to study the layouts of buildings in advance of their going into the buildings to measure the spaces, and thus, make the task easier; secondly, they serve as base records in the development of final up-dated floor plan diagrammatics which are an integral part of a perpetual space inventory system.

During the pre-inventory period, plans should be assembled for all buildings that are to be surveyed. For the purposes of the inventory, the most up-to-date small scale drawings are desirable. Two sets of such drawings for each building provide an excellent working situation. The surveyors can carry one set out when they inventory the buildings and record on it room number changes, remodeling changes, etc., while in the field. When the building has been inventoried, the changes and notations can be transcribed onto the second set in a more precise manner for use by the coding personnel and by the draftsmen working up the tracings for the final floor plan diagrammatics. The marked up plans constitute an important record. Having the second set guards against loss in addition to providing a more accurate and legible record.

When small-scale plans are not available for a building, construction drawings must be secured. If neither are to be had, an on-site inspection of the building for the purpose of sketching up the floor layouts is strongly recommended. In addition to regular building plans, remodeling drawings should be secured for those buildings which have been altered, in order that information on each building is as complete as possible. A file folder should be set up for each building, properly identified by code and building name, to contain the plans available for the building. In the final stage of the inventory, the up-dated tracings and copies of the floor plan diagrammatics for the buildings may be filed in the respective folders. Bulky construction drawings will need to be stored separately in some file order.

Computer Programs

The worth of any inventory system is measured on the basis of its ability to ultimately provide in varied formats and in an expeditious manner the detailed and summary space information needed by the institution. During the pre-inventory period the institution's space information needs must be identified and translated into the specific forms of the output data that the system will be called upon to generate for space reporting and projecting. When the desired outputs have been established, the required input data can be identified and a room inventory form structured for collecting these data. With both input and output clearly defined, it remains for the space officer to set up the formats of the desired reports and for a computer programmer to write the programs needed to machine process the data and generate the desired reports.

Room Information

The basic unit of the physical facilities inventory is the individual room. In order that the total building area of an institution can be properly classified and reported, it is essential that the following elements be identified for each room.

Designation: Each room must be designated with a building code, floor level and a unique room number. Rooms generally carry numbers on or above the doors, but circulation and some mechanical areas, for example, have no such designation. The building plans discussed in a foregoing section of this appendix provide the means for locating and designating each room or space that is to be inventoried.

Capacity: It is necessary that the student station capacity be reported for each room assigned to scheduled instruction. Such information is pertinent to the room scheduling process and is required for room utilization studies.

Assignment: A record of the assignment of rooms and areas in a building is an integral part of the physical facilities inventory. Each room record must contain the code for the occupant or unit which is responsible for the space. This code is selected from the division-department code list.

Classification: Each room must be identified on the basis of its use and classified in accordance with the space classification system.

Area Measurement: The area in square feet is to be derived and recorded in some consistent manner for each of the rooms which constitute the net area of a building. The actual procedure for measuring a room, as employed in the case study, is described on page A-59. The gross area is to be determined for each building and reported on the basis of the criteria presented on page A-2.

Other Information: In addition to the essential room information discussed above, the following items were considered to be useful and were collected in the case study.

1. Capacities of rooms such as offices, reading rooms, conference rooms, research laboratories, etc. (These data were found useful for assessing the adequacy of existing spaces and for internal planning.)

2. Dimensions of rooms consisting of one or two rectangles. (These allowed for computer computation of areas which is highly desirable and served as an aid in constructing floor plan diagrammatic tracings.)

3. Designation, assignment and classification of each of the rooms comprising a suite; recording of the total area and station capacity of each suite by the room number identifying the suite; and use of an alphabetic suite identification symbol to identify the rooms comprising each specific suite within a building. (It was felt that such treatment of suites would result in a more accurate inventory record and room utilization study.)

4. Percentage prorations of rooms having two or more assignments, two or more functional uses or a combination of the foregoing; and a unique identification of each prorated portion. (These items were considered necessary for a more precise inventory of the institution's space.)

Room Inventory Data Sheet

A room inventory coding form must be developed for systematically collecting space information. It should call for the specific input items and information that are to be collected for each room. Page A-32 illustrates the room inventory form developed and used in conducting the physical facilities inventory in the case study. In view of the vast number of rooms and spaces that had to be physically measured, it was deemed most desirable to use a form which was an individual room

ROOM INVENTORY DATA SHEET

INSTITUTION NAME

Updating Code:
1-Delete 3-Addition
2-Change

1									

Serial Number:

2	3	4	5	6

Building Name: ____________________

Code:

7	8	9	10

Floor Level:

11	12	13

Room Number:

14	15	16	17	18	19

Card Number:

20

Percent of Proration:

21	22	23

Number of Stations:

24	25	26

Division Code:

27	28

Department Name: ____________________

Code:

29	30	31	32

Room Type: ____________________

Category Code:

33	34	35

Room Type Code:

36	37	38

Suite I.D.

39

Rectangular Space:

Primary Dimensions:

D_1

40	41	42	'	43 "

D_2

44	45	46	'	47 "

Secondary Dimensions:

D_1'

48	49	50	'	51 "

D_2'

52	53	54	'	55 "

Non-Rectangular Space:

56	57	58	59	60	61	$ft.^2$

Surveyors: ____________ ____________ ____________
Date: ____________________

Coder: ____________
Date: ____________

Coordinator: ____________
Date: ____________

record. It was judged that such a form would provide maximum flexibility for arranging the rooms in room number and floor level sequence prior to keypunching the data on cards. An added advantage was the fact that dimensions and shapes of non-rectangular spaces could be recorded on the backs of the respective forms and the areas computed by the surveyors upon their return to the inventory headquarters. However, more conventional coding forms are employed by many institutions.

Instructions for Completing the Room Inventory Data Sheet

Experience has shown that if inventory personnel are to do their work in an expedient and consistent manner, guide-lines for conducting the inventory must be set down in writing during the pre-inventory period. Specific instructions with respect to measuring spaces, computing non-rectangular areas, filling in the several fields of the room inventory data sheet, etc., must be available in duplicated form for distribution and review at the time of personnel orientation and for reference purposes in the field. Instructions for conducting the inventory and completing the room inventory data sheet, as developed in the case study, are presented below.

Updating Code (Box 1): The updating code must be recorded on every inventory data sheet, as it is the key instruction for processing the data. The code is to be used as follows:

1. Delete -- to be used when it is desired to erase all data on the tape for a given record or records. A one in box 1 and the serial number will delete all data recorded for the particular room or portion of a room related to the serial number shown. The entire room record, including all prorated portions, can be deleted by recording a one in box 1, the building code, the floor level and the number of the room to be deleted. An entire floor, including all room records, may be deleted by recording a one in box 1, the building code, and the level of the floor to be deleted. An entire building can be deleted by recording a one in box 1 and the code of the building to be deleted. For any of the above types of deletions only the specified information is to be entered on the room inventory data sheet.

2. Change -- to be used when it is necessary to change any or all of the data on the tape for a given room or portion of a room. A two in box 1, the serial number, and the corrected data will effect the change(s) on the room inventory file for the room or portion of a room which relates to the serial number shown.

   If it is necessary to change any data other than building code, floor level, or room number for an entire room (including all prorated portions of that room), then a two in box 1, the building code, floor level, room number and corrected data will effect the change(s). In either case, only those data which are to be changed should be entered on the data sheet.

3. Addition -- to be used when a new room or prorated portion of a room is to be added to the inventory file. If a room is to be added to the file, a three in box 1 and all of the data for the room except serial number must be entered on the form. If a new prorated portion of a room is to be added, then a three in box 1 and all of the data for the room except serial number, dimensions or actual area must be entered on the data sheet.

Serial Number (Boxes 2, 3, 4, 5 and 6): This number will be serially assigned by the computer when all rooms and portions of rooms have been sorted by card number, within floor level, within building code. The number will then serve as the control field when deleting or changing existing records but will not be used when adding new records. Inasmuch as it is assigned by computer, it is not used during the initial inventory. The serial number will be numeric and right justified without leading zeros.

Building Name and Code (Boxes 7, 8, 9 and 10): Consult the building code list for the building name and code. Record the building name (or abbreviation of name) on the line indicated, and the building code in the appropriate boxes. The building code should be right justified without leading zeros.

Floor Level (Boxes 11, 12 and 13): Each floor level should be designated by a unique number, e.g., first floor -- 01, second floor -- 02, first basement -- B1, etc. Mezzanines require an additional "M" designation; e.g., the mezzanine level between the first and second floors should be designated 01M, whereas such a level occurring between the first and second basement floors should be designated B1M. In the event of a mezzanine level occurring between the first floor and the first basement, a designation B*M should be used. The floor level designation must be entered in boxes 11, 12 and 13 with a numeric or "B" in box 11. Box 13 should contain an "M" when designating a mezzanine level but must remain blank when recording other floor levels. (See Figure 1 on page A-36.)

Room Number (Boxes 14, 15, 16, 17, 18 and 19): The number occurring on or above the door of the room should be used to designate the room in the inventory whenever possible. If no number exists, or if duplicate room numbers occur, then a proper room number must be assigned according to the following rules:

1. Generally a room is a space separated from other spaces by at least 6'6" partitions or floor-to-ceiling walls.

2. Each room (including circulation spaces) must have a unique number.

3. The room number should indicate the floor level if possible.

4. Rooms on a mezzanine level should have a leading "M" designation.

5. Rooms below grade should have a "B" designation.

6. A room or rooms off of a room should have a single letter suffix beginning with the letter "A".

7. The numbers 100, 200, 300, etc., on each floor level should be reserved for circulatory spaces. A suffix "code" such as the one shown below may be used to give each space a unique designation.

   A through G -- stairways
   H through I -- elevators
   j through Z -- corridors and vestibules

   The letter O should be used only when necessary, due to the fact that it may be confused with the number zero. If more circulatory spaces occur than there are suffixes to accommodate them, then the thousands series may be instituted to follow on the hundreds.

Examples of the coding system for two typical room numbering schemes and their corresponding floor levels are shown in Figure 1.

Floor Level

11	12	13
0	3	
0	2	M
0	2	
0	1	M
0	1	
B	*	M
B	1	
B	1	M
B	2	

100's Series Room Numbers

14	15	16	17	18	19
		3	0	1	A
M		2	0	1	A
		2	0	1	A
M		1	0	1	A
		1	0	1	A
M	B	*	0	1	A
	B	1	0	1	A
M	B	1	0	1	A
	B	2	0	1	A

1000's Series Room Numbers

14	15	16	17	18	19
	3	0	0	1	A
M	2	0	0	1	A
	2	0	0	1	A
M	1	0	0	1	A
	1	0	0	1	A
M	*	0	0	1	A
B	1	0	0	1	A
X	1	0	0	1	A
B	2	0	0	1	A

Figure 1: Examples of the coding of two typical room numbering schemes and their corresponding floor levels.

Inasmuch as it is impractical to illustrate the manner in which all room numbering schemes may be coded, the general specifications shown below must be followed when filling in the boxes for the room number designation:

Box 14 -- Alphabetic
Box 15 -- Alpha-numeric
Box 16 -- Alpha-numeric
Box 17 -- Numeric
Box 18 -- Numeric
Box 19 -- Alphabetic

(The above system is incorporated in all of the computer programs which have been written for the purpose of machine processing the inventory data.)

Card Number (Box 20): The card number is used in conjunction with the building code, floor level and room number to give each prorated portion of a room a unique identification; thus assuring that the prorated portions will remain in the correct order during a computer sort.

Initially the coder should assign a zero card number to every room since no rooms are to be prorated at this stage. During the departmental update, however, card numbers are to be assigned sequentially to each prorated portion of a room .

Percent of Proration (Boxes 21, 22 and 23): Percent of proration will apply in the following cases: (a) when a room is shared by and assigned to two or more departments; (b) when a room serves two or more functional uses (i.e., two or more categories and/or room types); and (c) when some combination of the foregoing occurs. During the initial coding of assignment and functional use for each room, no proration is made and the figure 100 is entered in boxes 21, 22 and 23. (If past records reflect splits in assignment or functional use, the assignment and functional use having the greater prorated area should be shown on the data sheet.) When the initial print out of the space inventory is updated by the departments, the proper prorations should be secured with regard to assignment and/or functional use. In this way the prorations will become a part of the inventory record. The prorations are to be coded in such a way that each portion of a room is identified as to its respective number of stations, assignment, specific category and room type, and percentage of proration. The computer applies this percentage and the total area of the room to calculate prorated areas. The percent of proration entered in boxes 21, 22 and 23 should be right justified without leading zeros. The sum of the prorations of a room must always equal 100 percent.

Number of Stations (Boxes 24, 25 and 26): The number of stations should reflect the capacity of the room. Every station figure must represent the number of persons -- students or staff, according to the type of room -- that are being accommodated in the room at one time. (The above also applies to a portion of a prorated room.)

For the purpose of a room utilization study it is necessary to obtain station counts for all classrooms and instructional laboratories. Additionally, an institution may record station counts for offices, research labs and other types of facilities if the data can be put to use. The inventory teams may count and record number of stations for rooms in buildings which are physically measured. Station counts can be further derived and checked at the time of the departmental updating of the space inventory. Previous records of room capacities may also be used as a check in establishing number of stations for specific rooms.

The figure representing number of stations which is entered in boxes 24, 25 and 26 should be right justified without leading zeros.

Department Name, Division-Department Code (Boxes 27 and 28; 29, 30, 31 and 32): When physically measuring a room the inventory team should write in the abbreviated department name on the line provided on the data sheet if the assignment of the room can be ascertained. The filling in of the division - department codes should be reserved for the coder who will work from a code list set up by the inventory coordinator. The division code (boxes 27 and 28) designates the school, college or administrative unit which contains a given department and must be unique within the institution. The department code (boxes 29, 30, 31 and 32) designates a specific department within a division and must be unique within that division. In the coding process both the division and department codes should be right justified with leading zeros.

Room Type, Category and Room Type Codes (Boxes 33, 34 and 35; 36, 37, and 38): It is very helpful to have the inventory team write on the line provided a brief description of the apparent room type at the time the physical measurements are taken. Study and interpretation of the Space Classification System will insure a more accurate recording of room type by the surveyors.

It is the responsibility of the coder (being familiar with the category definitions) to enter the proper category code in boxes 33, 34 and 35. In addition, he will enter in boxes 36, 37 and 38 the code for the room type which most closely reflects the usage of the space. Both the category and room type codes should be right justified with leading zeros.

Suite Identification (Box 39): The suite identification is used to designate each of the rooms which comprise a particular suite by means of an alpha-numeric. A suite is defined as two or more rooms which are used as a single unit to accommodate a single functional use. The suite identification is intended primarily to provide a better record of instructional facilities for which utilization figures need to be derived.

Initially, the area and station figures should be recorded for a room whether or not it is part of a suite. The coder may at this time identify those instructional rooms that are known to comprise suites by use of suite designation letters. During the departmental update all instructional suites should be identified and the room number which is used to designate the suite in the timetable should carry the total area (in boxes marked "actual area") and total stations for the suite. For the other room or rooms comprising the suite, asterisks are to be inserted for number of stations and for actual area, with the number of asterisks identifying the magnitude of the capacity and area figures. The actual dimensions for each room can still be maintained on the tape if they are recorded on the form.

Rectangular Space: A room will be considered rectangular if its shape is such that the area is made up of one or two rectangles. A room that is shaped in such a way that it requires three or more rectangles or a shape other than a rectangle to define its area will be considered non-rectangular. If a room is rectangular the area will be calculated by the computer from the primary and secondary dimensions and no actual area figure is to be recorded on the data sheet. All dimensions should be taken from inner wall to inner wall.

1. Primary Dimensions -- If the shape of the room is such that one rectangle defines the area of the room, then it is necessary to measure only the primary dimensions, D_1 and D_2.

    a. D_1 (Boxes 40, 41 and 42; and 43)-- the dimension parallel to a line from the door through which one enters to the opposite wall. Record the number of feet in boxes 40, 41 and 42. This number should be right justified without leading zeros. Record the nearest quarter foot in inches (0", 3", 6" or 9") in box 43.

    b. D_2 (Boxes 44, 45 and 46; and 47) -- the dimension perpendicular to D_1. The number of feet should be right justified without leading zeros and recorded in boxes 44, 45 and 46. The nearest quarter foot in inches should be recorded in box 47.

2. Secondary Dimensions -- If the shape of a room is such that two rectangles are needed to define the area, then both the primary and secondary dimensions must be recorded. The primary dimensions should reflect the larger area while the secondary dimensions reflect the smaller. (It should be noted that when a room can be divided into two rectangles, it may be done in two ways. In the interest of consistency, it is recommended that the room be divided in such a manner that the area defined by D_1 and D_2 be as large as possible.)

a. D_1' (Boxes 48, 49 and 50; and 51)-- the dimension of the smaller rectangle which is parallel to D_1. Record the number of feet in boxes 48, 49 and 50. This number should be right justified without leading zeros. Record the nearest quarter foot in inches (0", 3", 6", or 9") in box 51.

b. D_2' (Boxes 52, 53 and 54; and 55) -- the dimension of the smaller rectangle which is perpendicular to D_1. The number of feet should be right justified without leading zeros and recorded in boxes 52, 53 and 54. The nearest quarter foot in inches should be recorded in box 55.

Non-Rectangular Space: A non-rectangular space is one whose shape is such that it requires three or more rectangles or a shape other than a rectangle to define its area. The dimensions recorded should be taken from inner wall to inner wall and must define the total area of the room.

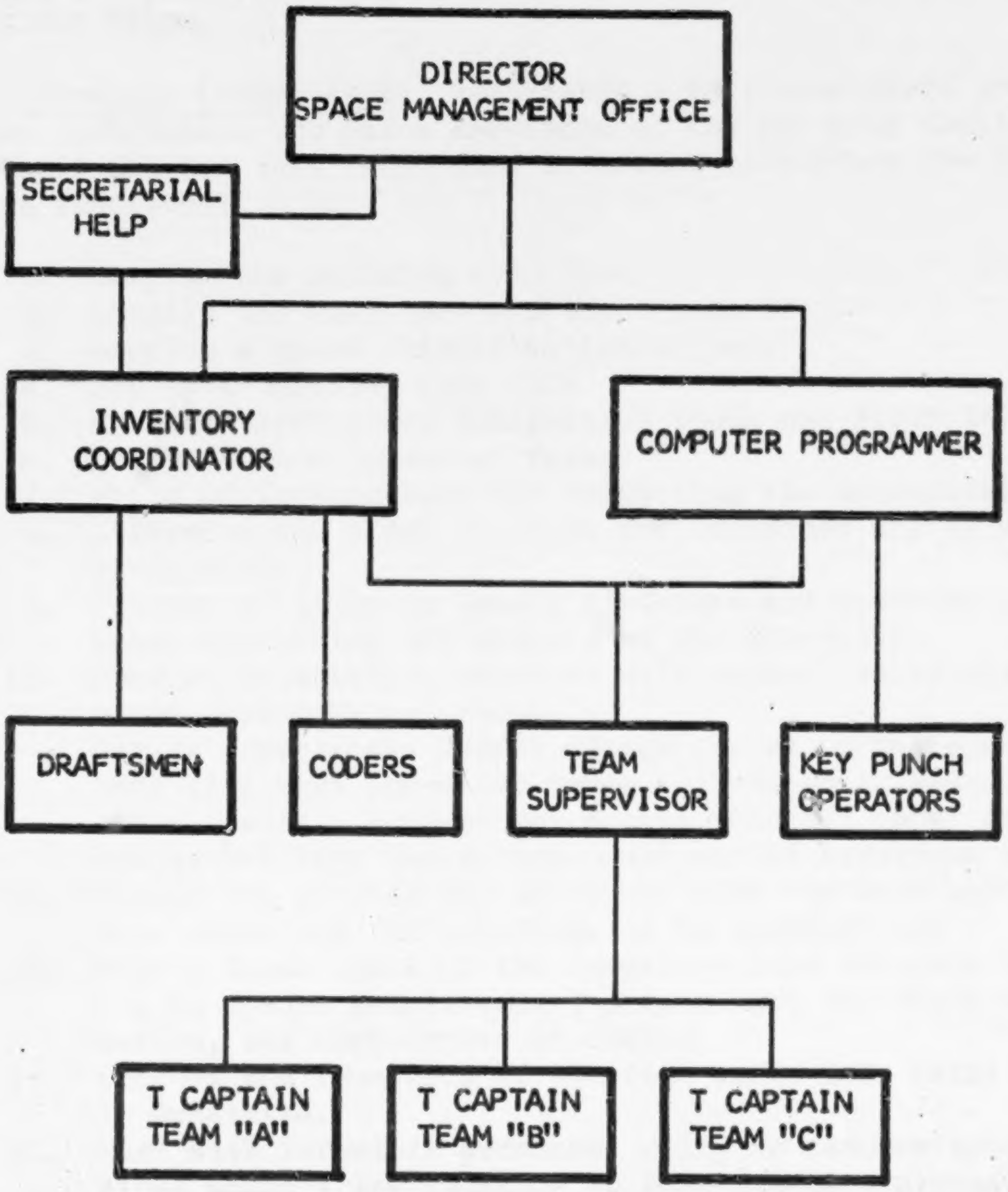
1. Actual Area (Boxes 56, 57, 58, 59, 60 and 61) -- The dimensions which define the total area of a non-rectangular space should be written on the back of the data sheet on which the room number is recorded. It may also be helpful to sketch the spaces on the back of the data sheet.

   The coders should calculate the actual areas of non-rectangular spaces by means of desk calculators and enter these figures in boxes 56, 57, 58, 59,60 and 61. The area figure should be right justified without leading zeros. All actual area computations should be checked by the team supervisor or inventory coordinator prior to keypunching the data.

Inventory Personnel

The overall task of developing and conducting a perpetual inventory system at a large institution is a major undertaking requiring a vast amount of organized effort. The success of the undertaking depends in large measure on the experience and, more often, dedication of the persons assigned to the task. This section describes the organization and personnel required to accomplish such a task and reflects the experience of the case study. The organizational chart on page A-41 assumes the existence of a space office and the staffing of the space inventory operation under the director of that office. Of the inventory personnel identified in the organizational chart, the director of the space

PERSONNEL REQUIREMENTS FOR
PHYSICAL FACILITIES INVENTORY


DIRECTOR
SPACE MANAGEMENT OFFICE
SECRETARIAL HELP
INVENTORY COORDINATOR
COMPUTER PROGRAMMER
DRAFTSMEN
CODERS
TEAM SUPERVISOR
KEY PUNCH OPERATORS
T CAPTAIN TEAM "A"
T CAPTAIN TEAM "B"
T CAPTAIN TEAM "C"

office, the inventory coordinator and the secretarial help may be viewed as permanent staff people. The team supervisor and the surveyors comprising the inventory teams may be temporary workers. The computer programmer, professional draftsman, coders and keypunch operators may be permanent staff members in the space office or they may be drawn upon from other campus operations. For institutions comparable in size to the University of Wisconsin, Madison Campus, the inventory personnel recommended are shown below.

Inventory Coordinator: Preferably a full time staff person at the institution who has a knowledge of the physical facilities and their usage. This individual is needed to perform the following functions:

1. Compile the building code list.
2. Compile the division-department code list.
3. Develop a space classification system.
4. Set up a building plan file.
5. Devise a system for designating rooms and floor levels.
6. Design a room inventory form.
7. Write up instructions for conducting the inventory.
8. Determine the order in which the buildings are to be inventoried.
9. Prepare a letter to deans, directors and department heads explaining the purpose of the inventory.
10. Conduct orientation sessions with student surveyors and other inventory personnel.
11. Notify departments and/or custodians as to the approximate time that inventory teams will be in to measure their spaces. Arrange for access into all rooms and spaces but keep survey personnel out of hazardous areas.
12. Secure and provide the surveyors with the most up-to-date plans for the buildings to be inventoried.
13. Make a final check of the inventory data for each building to assure completeness, proper room and floor designation, and correctness of coding.
14. Perform the functions of the team supervisor until he is appointed.
15. Meet with inventory personnel daily to resolve questions which arise relative to the inventory procedure.
16. Coordinate and generally supervise the total inventory effort and assist with measuring, coding, etc., to keep the inventory on schedule.

Team Supervisor: If three or more survey teams are working in the field, a team supervisor may be appointed to assist the inventory coordinator in expediting the inventory. From the experience of the case study, it is recommended that such a person be selected from the surveyor group after two or three weeks of inventorying. The selection should be made on the basis of responsibility, comprehension of the total inventory process, and ability to manage people. This individual would perform the following functions:

1. Provide detailed supervision for the teams.
2. Schedule teams to buildings.
3. Compute all non-rectangular areas.
4. Check inventory data by building for completeness and correctness.
5. Check the room numbering scheme of each building for compatibility with the room numbering system set up for the inventory.
6. Punch and bind room inventory data sheets.
7. Substitute for absent team members.

Three-man Inventory Teams: In conducting the physical facilities inventory in the case study, it was found that three-man teams were very efficient for physically measuring space. The number of teams required to inventory an institution's space is contingent upon the volume of work that needs to be done and the time period allotted for accomplishing the task. Experience showed that one team, working during the institution's regular eight hour day, could inventory 20,000 net square feet of space per day on the average. Student surveyors were employed in the case study. It proved valuable from the beginning to designate one member of each three-man team as team captain. This individual coordinated the team effort and answered directly to the team supervisor and inventory coordinator for the actions of the team.

In the case study the time schedule allowed for the inventorying of the physical facilities during the summer period. This may be the more opportune time to conduct an extensive inventory since approximately sixty working days can be scheduled over such a period, fulltime student help is likely to be more plentiful, and facilities may be less heavily used. In staffing up the teams, upper class students (preferably Engineering majors) may be sought. Experience proved, however, that students from other disciplines make excellent surveyors. In general, the employment of student help is recommended.

Each three-man team would perform the following functions:

1. Physically measure each space in the buildings assigned to the team.
2. Correct the building plans to reflect any changes in floor lay-out.
3. Develop sketches for buildings for which no plans are available, showing floor layouts and room numbers.
4. Assign numbers to rooms which do not carry numbers on or above the doors as well as to non-assignable spaces such as circulation areas. Make room number changes when existing numbers conflict with the room numbering system set up for the inventory. Record room numbers on building plans.
5. Record the required room information on the room inventory data sheet.

Computer Programmer: In view of the growing need for space information, a computerized inventory system should be employed by any institution having electronic data processing facilities available. Programming services may be secured by arrangement from a computer operation on the campus or a computer programmer may be brought onto the staff of the space office. The latter is more desirable. A fulltime programmer was required in the case study. Such a person is needed to perform the following functions:

1. Review space management procedures as they are being developed to identify those appropriate for computerization.
2. Review data collection forms and the structure of input information to insure that they are amenable to computer processing.
3. Write and test the necessary computer programs.

Draftsmen: The services of draftsmen will be required for developing floor plan diagrammatic tracings for all buildings in the inventory. The availability and condition of small-scale plans as well as the overall quantity of tracings which must be generated will determine the manpower required to accomplish the task. Part-time student help may be employed if brought under the direct supervision of a professional draftsman experienced in architectural drawing.

Coders: Based upon the experience of the inventory, one coder is needed for each three-man team. Individuals familiar with the building spaces and their assignment are most desirable.

In the interest of consistency and accuracy, a minimum number of persons should be involved in the coding of assignment and functional use of rooms. Inventory coders are required to perform the following functions:

1. Enter the updating code, assignment and functional use for each room; also the number of stations and serial number when necessary.
2. Check the computations of all non-rectangular areas.
3. Check room inventory data sheets against building plans to assure that a data sheet exists for each room.
4. Substitute for absent members of the inventory teams.

Keypunch Operators: Keypunching and verifying services may be secured by arrangement from a computer operation on the campus. Some space management operations may be able to justify having such personnel on their respective staffs. In either case, these individuals would be responsible for keypunching and verifying the data.

Secretarial Assistant: A fulltime secretary is needed to perform the office tasks generated by the inventory if it is conducted in a concerted manner.

Conducting the Physical Facilities Inventory

When the pre-inventory tasks have been completed and the required personnel are engaged, the actual inventorying can be undertaken. Effective organization and coordination of the total process is to be emphasized from the beginning. Inventory personnel must be trained and deployed in such a manner as to minimize the need for re-doing any portions of the inventory.

Data Collection

In the case study, the actual measuring of all building spaces on a room-by-room basis was determined to be the best procedure for securing the necessary input data. Scaling of construction drawings was not feasible, generally, due to the out-dated condition of plans and the inexperience of the student surveyors in reading construction documents.

It is recommended that the inventory system provide for machine computation of room areas whenever practical. In the case study, only the areas of rooms comprised of three or more rectangles and those having non-rectangular shapes were computed manually.

An orientation period for survey personnel should be set up for the following purposes: (a) to explain the overall process and objectives of the physical facilities inventory; (b) to review the instructions for measuring spaces and collecting the relevant data; (c) to interpret the rules-of-thumb to be applied in inventorying the institution's spaces; (d) to prescribe the conduct expected of surveyors when measuring spaces in buildings; and (e) to conduct a trial inventory of one building on the campus.

The trial inventorying of a building simultaneously by all teams is considered to be a very important part of the orientation process. The building should be relatively simple yet ought to contain spaces which accommodate a variety of uses and which are assigned to a number of departments. When the teams have completed inventorying the trial building, they can be assembled in a meeting for the purpose of reviewing and comparing the results of the team efforts. Differences can be studied and resolved. In general, it is felt that a two or three day period of orientation can do much to insure that the total inventory will be conducted in a more consistent and proper manner.

A letter explaining the purposes of the inventory and requesting cooperation with the survey personnel should be sent to all deans, directors and department chairmen and additional copies should be carried by the surveyors. (It is strongly recommended that this letter be signed and sent out by the administrative head of the institution.) A system for scheduling teams into buildings must be implemented and telephone arrangements made with administrative units a day or two before teams are to go in to measure their spaces. At the time of such contact, arrangements can be made for securing keys to spaces or for a person to unlock the spaces. Inventory personnel should be apprised at this time of areas which are hazardous and those which need to be surveyed with greater care because of the equipment contained therein, on-going experimentation, etc.

As the surveyors move through the buildings they must remain cognizant of the fact that they are guests of the building occupants and that courteous behavior is to be demonstrated at all times. If a team should enter a room, for example, in which a class or conference is in session, the intrusion should be excused and the space inventoried later when unoccupied.

As alluded to before, a three-man survey team -- with one member designated team captain -- was found to be an efficient unit. Such a team structure provides that two men can manipulate the tape and take dimensions while the third man unlocks and locks doors, records the data, and -- when necessary -- makes floor layout and room number changes on the existing building plans, or sketches floor layouts with room numbers for buildings having no plans. (Small buildings are somewhat the exception. Experience demonstrated that they can be scheduled in groups and efficiently inventoried by two-man teams.) After two or three weeks of work in the field, a surveyor exhibiting the desired aptitudes may be appointed to the position of team supervisor and given the responsibility of much of the detailed supervision and work heretofore performed by the inventory coordinator. The coordinator will need to give increasing time and attention to the coding and processing of the inventory data and the eventual production of the required inventory reports.

The physical facilities inventory should start with the simpler buildings -- such as classroom-office buildings -- and progress to the more complicated such as research buildings. When building plans are available, they should be studied by the surveyors in advance of their going into the buildings to inventory the spaces.

It was found that less supervision was needed when the teams were required to report each morning at the inventory headquarters to pick up equipment and supplies and receive their work assignments for the day and to report back at the close of the day with the results of the day's work. The return of the surveyors one-half hour early for the purpose of clarifying questions and checking over and sequencing the data sheets proved to be a useful practice.

The room inventory form developed for the case study was referred to earlier as were the instructions for completing this form. Both should be studied carefully by the inventory personnel to insure that the required input data for each room will be properly derived and recorded.

Special Problems and Suggested Solutions

In dimensioning large complex spaces, it is suggested that chalk marks be made on the floor to provide a visible record of the areas measured.

Generally, measurements should be taken at chest height when using a 16 foot tape or when spanning a distance up to 30 feet with a 50 foot tape. Special care must be exercised to insure that the tapes are pulled tight. Measurements exceeding 30 feet should be made at floor level and the baseboards taken into account.

All spaces that have a minimum ceiling height of 6'6" should be measured. Exceptions, however, are transformer rooms, particle accelerator rooms, disease labs containing on-going experimentation involving contagious elements, and other such hazardous areas. Spaces in which experiments are in progress -- which require a controlled environment or which may be disturbed by the surveyors -- should be measured only under the supervision of a representative of the department. In lieu of measuring spaces such as those enumerated above, the dimensions may be secured by scaling up-to-date construction drawings.

The area recorded for a stairway or elevator on a particular floor level should reflect the two-dimensional projection of the space at that level. In older buildings, where stairwells may not exist, this projection into two dimensions may present a problem. In general, any area under a stairway which has a height less than 6'6" should be included in the area of the stairway for that level. Stair landings on a particular floor level should also be included in the area of the stairway. The arbitrary dividing line between a stair landing and a corridor must be established by the survey team and shown on the floor plan diagrammatic by means of a broken line.

Generally, a corridor should be divided into sections when right angles occur and a unique number should be assigned to each section. Since the divisions are arbitrary, the division lines must be marked on the floor plan diagrammatics by the surveyors. When safety codes require that a lane or "phantom corridor" be kept open in a large open area for the purpose of ready egress, such a corridor should be indicated on the floor plan diagrammatic by means of broken lines and its area prorated out of the total area of the room.

The areas of closets which were contiguous to specific rooms were included in the total room area figures. Initially in the case study, such spaces were shown independently as contiguous areas as well as being included in the respective room area totals. It was found, however, that the square footage in contiguous space was not great enough to warrant reporting it unto itself.

Partitioned spaces should be designated with a unique number only if the fixed partitions are 6'6" or more in height. Fixed partitions less than 6'6" in height and movable partitions should be disregarded inasmuch as the room area can be prorated on the basis of multiple room uses which may be accommodated in the room.

To assist the coders in determining the assignment and functional use of a room, the surveyors should note on the data sheet the department occupying or maintaining the space and the apparent room type.

As stated previously, the room numbers recorded on the room inventory data sheets should agree with the room numbers shown for the respective spaces on the floor plan diagrammatics and, if at all possible, these should comply with the numbers on or over the doors of rooms.

The Initial Room Inventory File

As the building space is inventoried the room inventory data sheets must be checked for completeness, arranged and bound for keypunching on cards. Three-ring binders are suggested for the latter purpose. As the card records are read onto tape, computer audits of the data should be performed and cards containing detected errors rejected. A listing of these computer audits is found on page A-69. The resulting room inventory file tape is used to print out the preliminary space inventory report by building which should be visually scanned for additional errors; e.g., rooms missing from both the inventory report and the error diagnostic sheet, and inconsistencies betwen floor level designation and room number. The procedures used in correcting the inventory record at this time are the same as those applied in the maintenance of the inventory file, as described later in this section. The updated room inventory file can now be used to generate a revised report by building which may require further clean-up.

If the inventory is extensive, as was the situation in the case study, this task may be accomplished in two or more phases in order that the inventory workers can effect the clean-up of the data printed out for the first segment of the inventory while the measuring and coding of the remaining spaces is simultaneously brought along to the print out stage. When the several phases of the inventory have undergone clean-up, the respective files can be merged and used to generate a single revised report containing all of the inventory data. The space inventory by building is the report most basic to the initial inventory process as well as to the maintenance of the room inventory file.

The Floor Plan Diagrammatics File

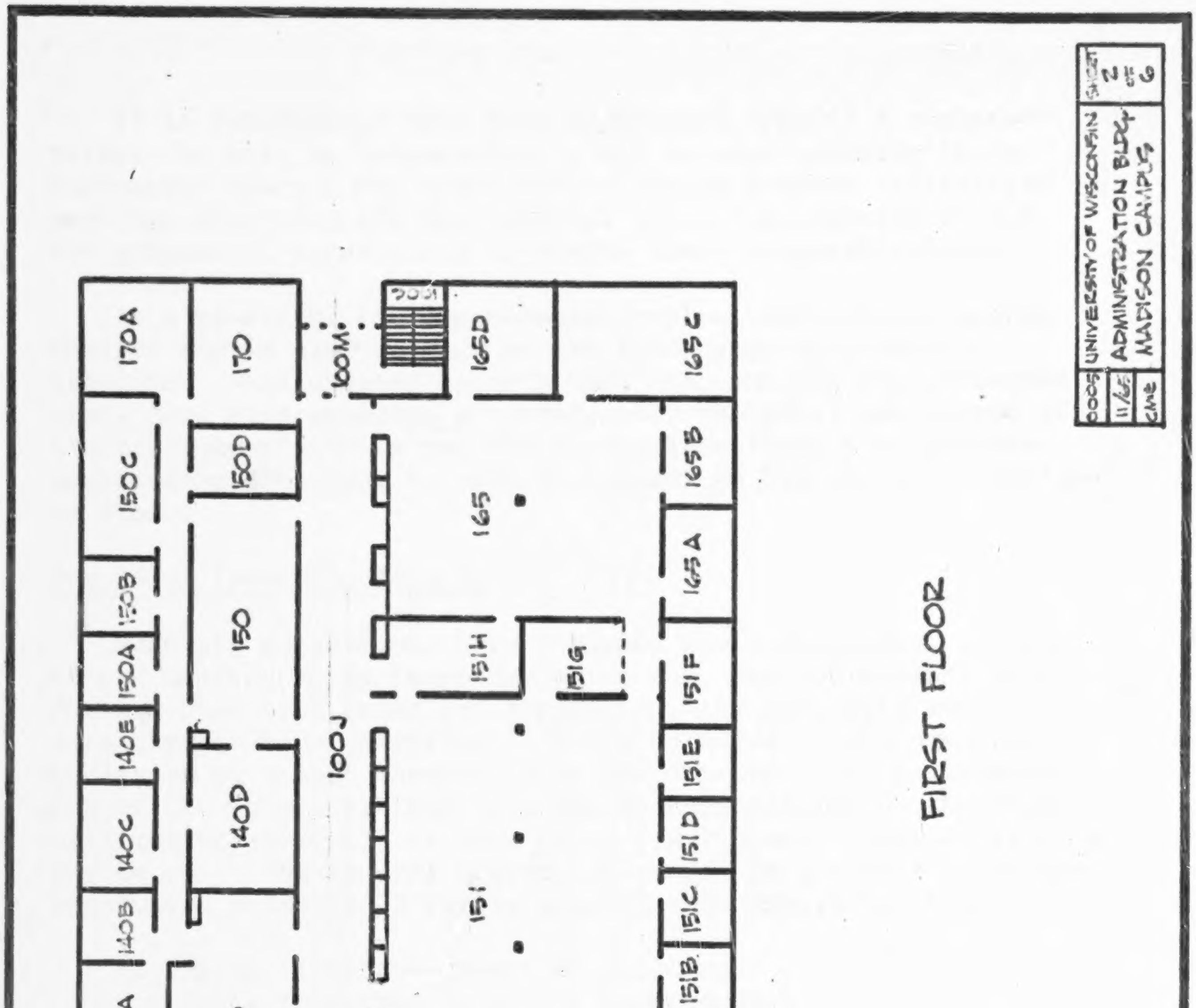
Floor plan diagrammatics for all buildings in the inventory need to be developed on tracing paper in single line form, showing the floor layout, room numbers and such other information as the institution may consider pertinent to its inventory. (See illustration on page A-51.) The tracings must be kept up-to-date so that sets of floor plan diagrammatics by building can be generated for the total inventory when required.

It was necessary to employ the most expedient procedures in developing a file of diagrammatic tracings for the case study because of the great volume of tracings which had to be generated in a relatively short period of time. An institution having no time restrictions or having a smaller volume of drawings to turn out might employ the conventional and direct procedure of drafting up the diagrammatics to a desired scale from the construction drawings. The use of micro-film equipment should be explored, particularly by large institutions. With such equipment large construction drawings can be placed on micro-film and printed in a size suitable for direct tracing of floor plan diagrammatics. A check of state agencies responsible for public buildings may turn up a micro-film file of the institution's buildings. Such a file, contained in the Bureau of Engineering for Wisconsin, was made available to this project and was used to a significant extent in the development of floor plan diagrammatic tracings for University of Wisconsin buildings. The floor plan diagrammatics file must be started early in the inventory process in view of the time required to generate the file. When the inventorying of the institution's space has been completed, a tracing for each floor in the inventory must be on hand so that a proper quantity of each of the floor plan diagrammatics can be produced. The diagrammatics are essential to the updating of the inventory with departments as discussed in the following section.

The Master Room Inventory File

The initial space inventory report by department and the floor plan diagrammatics must be reviewed by the departments for errors. At this time prorations of rooms should also be made and recorded on the print outs. The procedural steps for conducting the departmental review are discussed later in this appendix under the heading "Institutional Update."

FLOOR PLAN DIAGRAMMATIC


170A
170
100M
165D
165C
150C
150D
165
165B
150B
150
165A
150A
151H
151G
151F
140E
100J
151E
140D
140C
151D
140B
151
151C
151B
140A
140
123
151A
138
121
DN
UP 100B
101
100K
100L
130D
130
122
100A
122C
130C
130B
130A
122B
122A
120A
120
FIRST FLOOR
N
0 4 8 12 16 20
2 6 10 14 18
SCALE IN FEET
UNIVERSITY OF WISCONSIN
ADMINISTRATION BLDG.
MADISON CAMPUS
SHEET 2 of 6
0005
11/68
CMe

It is recommended that each department appoint a representative who will be responsible in all matters relating to departmental space. The space office should conduct orientation meetings involving the departmental space representatives for the purpose of acquainting them with their responsibilities.

As a result of the departmental review, corrections and/or changes should also be made on the floor plan diagrammatic tracings. When updated reports have been run and the corrected floor plan diagrammatics produced, both the print out record of the department's space and the appropriate floor plan diagrammatics should be sent to each department as its record of assigned space.

The Space Inventory Reports

When all departments have returned their respective copies of the updated space inventory print out, and corrections and changes have been coded and keypunched, the card data are audited in a card to tape operation. Errors detected by the computer audits or by visual scanning must be correctd. (A final updating of the room inventory file may be necessitated by the room utilization survey.) At this point final space inventory reports may be run. The several reports generated in the case study are enumerated below and a sample page of each report is shown.

1. Space Inventory Report by Building.
2. Space Inventory Report by Department.
3. Space Inventory Report by Category (detailed).
4. Space Inventory Report by Category within Building (summary).
5. Space Inventory Report by Category within Department (summary).

Three of the column headings appearing on the space inventory reports by building and by department may require further explanation. Prorated areas necessitate the use of both a MAF code and a card number. The MAF code identifies the types of prorations which are: 1 -- multiple functional use; 2 -- multiple assignment; and 3 -- a combination of the foregoing. A card number is assigned to each portion of a prorated room. These numbers run sequentially from zero through nine for a particular room. The serial number is used as a unique control field for each room or portion of a room. It is assigned by the computer and will, therefore, change each time the file is updated.

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FIRST SEMESTER 1965-66                         I N S T I T U T I O N   N A M E                                      PAGE NO.  567

  10/31/65                                       SPACE INVENTORY BY BUILDING

BLDG  BLDG     FLR   ROOM    CRD  SERIAL     TOTAL  PRO-    PRO   STA-   DIV-DEPT    DEPT     SPACE CL  CATEGORY  ROOM TYPE    S  MAF
CODE  ABBREV   LEV   NO      NO   NO         AREA   RATE    AREA  TIONS    CODE     ABBREV     CODE    ABBREV    ABBREV       D  CODE

1000  CHEM     B*M   MB*00A  0     9992        52  1.00      52          97 0200    G B S    901 900   CIRCUL    STAIR
1000  CHEM     B*M   MB*01   0     9993       496   .50     248          48 1500    CHEM     022 330   I LAB SR  L-G STOR         1
1000  CHEM     B*M   MB*01   1     9994       496   .50     248          48 1500    CHEM     104 330   R LAB SR  L-G STOR         1

                                                            496  NET ASSIGNABLE AREA - FLOOR TOTAL
                                                             52  NET NON-ASSIGN AREA - FLOOR TOTAL
                                                            548  NET AREA            - FLOOR TOTAL


1000  CHEM     B1    B100A   0     9995        52  1.00      52          97 0200    G B S    901 900   CIRCUL    STAIR
1000  CHEM     B1    B101    0     9996      1281  1.00    1281     25   48 1500    CHEM     020 020   INST LAB  WET LAB      A
1000  CHEM     B1    B102    0     9997       427  1.00     427      5   48 1500    CHEM     102 020   RES LAB   WET LAB
1000  CHEM     B1    B103    0     9998      ****  1.00    ****    ***   48 1500    CHEM     020 020   INST LAB  WET LAB      A
1000  CHEM     B1    B104    0     9999       128  1.00     128          48 1500    CHEM     022 300   I LAB SR  DISTRIB
1000  CHEM     B1    B105    0    10000        47  1.00      47          48 1500    CHEM     041 502   AC OF SR  STORAGE
1000  CHEM     B1    B106    0    10001       186  1.00     186          97 0200    G B S    903 960   REST RM   RESTRM M
1000  CHEM     B1    B107    0    10002        20  1.00      20          97 0200    G B S    900 852   CUSTOD    JAN RM
1000  CHEM     B1    B108    0    10003       231   .67     154      2   48 1500    CHEM     040 524   ACAD OFF  G OFFICE         1
1000  CHEM     B1    B108    1    10004       231   .33      77      1   48 1500    CHEM     100 524   RES OFF   G OFFICE         1
1000  CHEM     B1    B109    0    10005       682  1.00     682          97 0200    G B S    902 920   MECH      MECH EQ

                                                           2114  NET ASSIGNABLE AREA - FLOOR TOTAL
                                                            940  NET NON-ASSIGN AREA - FLOOR TOTAL
                                                           3054  NET AREA            - FLOOR TOTAL


1000  CHEM     01     100A   0    10006        52  1.00      52          97 0200    G B S    901 900   CIRCUL    STAIR
1000  CHEM     01     100J   0    10007       163  1.00     163          97 0200    G B S    901 906   CIRCUL    CORRIDOR
1000  CHEM     01     101    0    10008       238   .50     119      1   48 1500    CHEM     040 520   ACAD OFF  F OFFICE         2
1000  CHEM     01     101    1    10009       238   .50     119      1   68 1000    PHARM    040 520   ACAD OFF  F OFFICE         2
1000  CHEM     01     102    0    10010       125  1.00     125      1   50 1000    LIBR     060 520   LIBR OFF  F OFFICE
1000  CHEM     01     103    0    10011      1594   .30     478     42   50 1000    LIBR     062 640   LIBR S&S  READ RM          3
1000  CHEM     01     103    1    10012      1594   .50     797          50 1000    LIBR     062 646   LIBR S&S  STACKS           3
1000  CHEM     01     103    2    10013      1594   .20     319          48 1500    CHEM     041 502   AC OF SR  STORAGE          3
1000  CHEM     01     106    0    10014       315  1.00     315          97 0200    G B S    903 962   REST RM   REST RM W

                                                           1957  NET ASSIGNABLE AREA - FLOOR TOTAL
                                                            530  NET NON-ASSIGN AREA - FLOOR TOTAL
                                                           2487  NET AREA            - FLOOR TOTAL

                                                           4567  NET ASSIGNABLE AREA - BLDG TOTAL
                                                           1522  NET NON-ASSIGN AREA - BLDG TOTAL
                                                           6089  NET AREA            - BLDG TOTAL
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FIRST SEMESTER 1965-66                                     I N S T I T U T I O N   N A M E                                    PAGE NO.  183

   10/31/65                                                  SPACE INVENTORY BY DEPARTMENT

BLDG  BLDG    FLR   ROOM   CRD  SERIAL   TOTAL PRO-    PRO  STA-   DIV-DEPT   DEPT    SPACE CL  CATEGORY  ROOM TYPE    S  MAF
CODE  ABBREV  LEV    NO    NO    NO      AREA  RATE    AREA TIONS    CODE     ABBREV    CODE    ABBREV    ABBREV       D  CODE

1000  CHEM    B*M   MB*01   0    9993     496   .50     248          48 1500   CHEM     022 330  I LAB SR  L-G STOR        1
1000  CHEM    B*M   MB*01   1    9994     496   .50     248          48 1500   CHEM     104 330  R LAB SR  L-G STOR        1
1000  CHEM    B1     B101   0    9996    1281  1.00    1281   25     48 1500   CHEM     020 020  INST LAB  WET LAB      A
1000  CHEM    B1     B102   0    9997     427  1.00     427    5     48 1500   CHEM     102 020  RES LAB   WET LAB
1000  CHEM    B1     B103   0    9998    ****  1.00    ****  ***     48 1500   CHEM     020 020  INST LAB  WET LAB      A
1000  CHEM    B1     B104   0    9999     128  1.00     128          48 1500   CHEM     022 300  I LAB SR  DISTRIB
1000  CHEM    B1     B105   0   10000      47  1.00      47          48 1500   CHEM     041 502  AC OF SR  STORAGE
1000  CHEM    B1     B108   0   10003     231   .67     154    2     48 1500   CHEM     040 524  ACAD OFF  G OFFICE        1
1000  CHEM    B1     B108   1   10004     231   .33      77    1     48 1500   CHEM     100 524  RES OFF   G OFFICE        1
1000  CHEM    01      101   0   10008     238   .50     119    1     48 1500   CHEM     040 520  ACAD OFF  F OFFICE        2
1000  CHEM    01      103   2   10013    1594   .20     319          48 1500   CHEM     041 502  AC OF SR  STORAGE         3

                                                       3048  NET ASSIGNABLE AREA - BUILDING TOTAL


1005  CHEM R  01      101   0   10097     178  1.00     178    2     48 1500   CHEM     100 522  RES OFF   C OFFICE
1005  CHEM R  01     101A   0   10098     145  1.00     145    1     48 1500   CHEM     100 520  RES OFF   F OFFICE
1005  CHEM R  01      102   0   10099     389  1.00     389    5     48 1500   CHEM     102 020  RES LAB   WET LAB
1005  CHEM R  01      104   0   10100      63  1.00      63          48 1500   CHEM     104 314  R LAB SR  APPAR CL
1005  CHEM R  01      105   0   10103      96  1.00      96          48 1500   CHEM     104 308  R LAB SR  BALANCE
1005  CHEM R  01      107   0   10105     233  1.00     233    3     48 1500   CHEM     102 020  RES LAB   WET LAB
1005  CHEM R  01      109   0   10110     421   .10      42          48 1500   CHEM     101 502  R OFF SR  STORAGE         1
1005  CHEM R  01      109   1   10111     421   .90     379          48 1500   CHEM     104 502  R LAB SR  STORAGE         1
1005  CHEM R  01      110   0   10112     225  1.00     225    2     48 1500   CHEM     040 520  ACAD OFF  F OFFICE
1005  CHEM R  01      111   0   10113     270  1.00     270    3     48 1500   CHEM     040 522  ACAD OFF  C OFFICE
1005  CHEM R  01      112   0   10115     623  1.00     623    8     48 1500   CHEM     040 524  ACAD OFF  G OFFICE

                                                       2643  NET ASSIGNABLE AREA - BUILDING TOTAL

                                                       5691  NET ASSIGNABLE AREA - DEPARTMENT TOTAL
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FIRST SEMESTER 1965-66            INSTITUTION NAME                                PAGE NO. 251

  10/31/65                        SPACE INVENTORY BY CATEGORY

          CATEGORY CODE  020
          CATEGORY NAME  INSTRUCTIONAL LABORATORY

DIV-DEPT   DEPT    BLDG   BLDG    ROOM   CARD      TOTAL  PRO-   PRO     STA-     RM TYPE  RM TYPE  S MAF
  CODE    ABBREV   CODE  ABBREV    NO     NO       AREA   RATE   AREA    TIONS     CODE    ABBREV   D CODE

48 1500   CHEM     1000   CHEM    B101    0        1281  1.00    1281     25       020     WET LAB  A
48 1500   CHEM     1000   CHEM    B103    0        ****  1.00    ****     **       020     WET LAB  A

                          BUILDING TOTAL   - NET ASSIGNABLE AREA  1281

                          DEPARTMENT TOTAL - NET ASSIGNABLE AREA  1281


48 3200   GEOL       53   SCI HL  B170    0         709  1.00     709     24       020     WET LAB
48 3200   GEOL       43   SCI HL   188    0         488  1.00     488     16       022     DRY LAB

                          BUILDING TOTAL   -  NET ASSIGNABLE AREA 1197

48 3200   GEOL      803   911 U    103    0         365  1.00     365     12       022     DRY LAB

                          BUILDING TOTAL   - NET ASSIGNABLE AREA   365

                          DEPARTMENT TOTAL - NET ASSIGNABLE AREA  1562


48 6000   MUSIC     485   MUSIC    101    0         234  1.00     234      7       032     GRP PRAC
48 6000   MUSIC     485   MUSIC    122    0         594  1.00     594     18       032     GRP PRAC

                          BUILDING TOTAL   - NET ASSIGNABLE AREA   828

                          DEPARTMENT TOTAL - NET ASSIGNABLE AREA   828


48 6700   PHYS       57   STERL   1325    0        1082  1.00    1082     16       020     WET LAB
48 6700   PHYS       57   STERL   2301    0        1561  1.00    1561     24       022     DRY LAB

                          BUILDING TOTAL   - NET ASSIGNABLE AREA  2643

                          DEPARTMENT TOTAL - NET ASSIGNABLE AREA  2643
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10/31/65

SPACE INVENTORY BY CATEGORY WITHIN BUILDING

BLDG CODE 1000
BLDG NAME CHEM

CAT. CODE	CATEGORY NAME	TOTAL AREA
020	INSTRUCTIONAL LABORATORY	1281
022	INSTRUCTIONAL LABORATORY SERVICE	376
040	ACADEMIC OFFICE	392
041	ACADEMIC OFFICE SERVICE	366
060	LIBRARY OFFICE	125
062	LIBRARY STUDY & STACK	1275
100	RESEARCH OFFICE	77
102	RESEARCH LABORATORY	427
104	RESEARCH LABORATORY SERVICE	248
900	CUSTODIAL	20
901	CIRCULATION	319
902	MECHANICAL	682
903	REST ROOM	501
	BUILDING TOTAL - NET ASSIGNABLE AREA	4567
	BUILDING TOTAL - NET NON-ASSIGN AREA	1522
	BUILDING TOTAL - NET AREA	6089

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  10/31/65

                          SPACE INVENTORY BY CATEGORY WITHIN DEPARTMENT

                     DIV-DEPT CODE      48 1500
                     DIV-DEPT NAME      CHEM

                     CAT.                                            TOTAL
                     CODE           CATEGORY NAME                     AREA

                     020  INSTRUCTIONAL LABORATORY                    1281
                     022  INSTRUCTIONAL LABORATORY SERVICE             376
                     040  ACADEMIC OFFICE                             1391
                     041  ACADEMIC OFFICE SERVICE                      366
                     100  RESEARCH OFFICE                              400
                     101  RESEARCH OFFICE SERVICE                       42
                     102  RESEARCH LABORATORY                         1049
                     104  RESEARCH LABORATORY SERVICE                  786

                          DEPARTMENT TOTAL - NET ASSIGNABLE AREA      5691
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The Data Processing System

Appendix E contains a generalized flow chart representation of the data processing systems developed for the methodology. The system which supported the physical facilities inventory in the case study is shown as one section of this chart. A brief description of each integral part is included. Although the systems were implemented by specific available hardware, all computer programs were written in COBOL to provide maximum future compatibility. The computer programs written for the methodology are supplemental to this report.

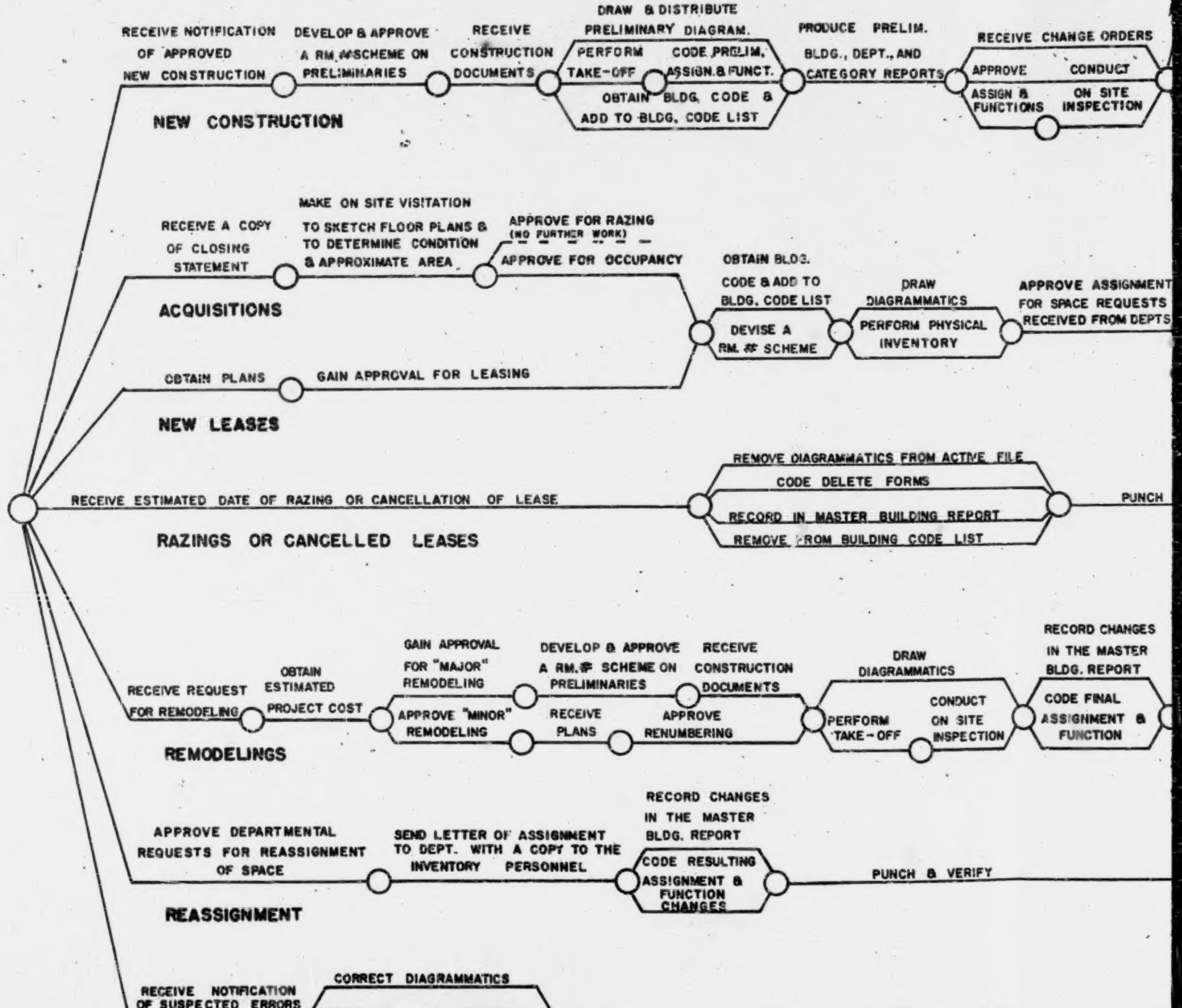
File Maintenance Procedure

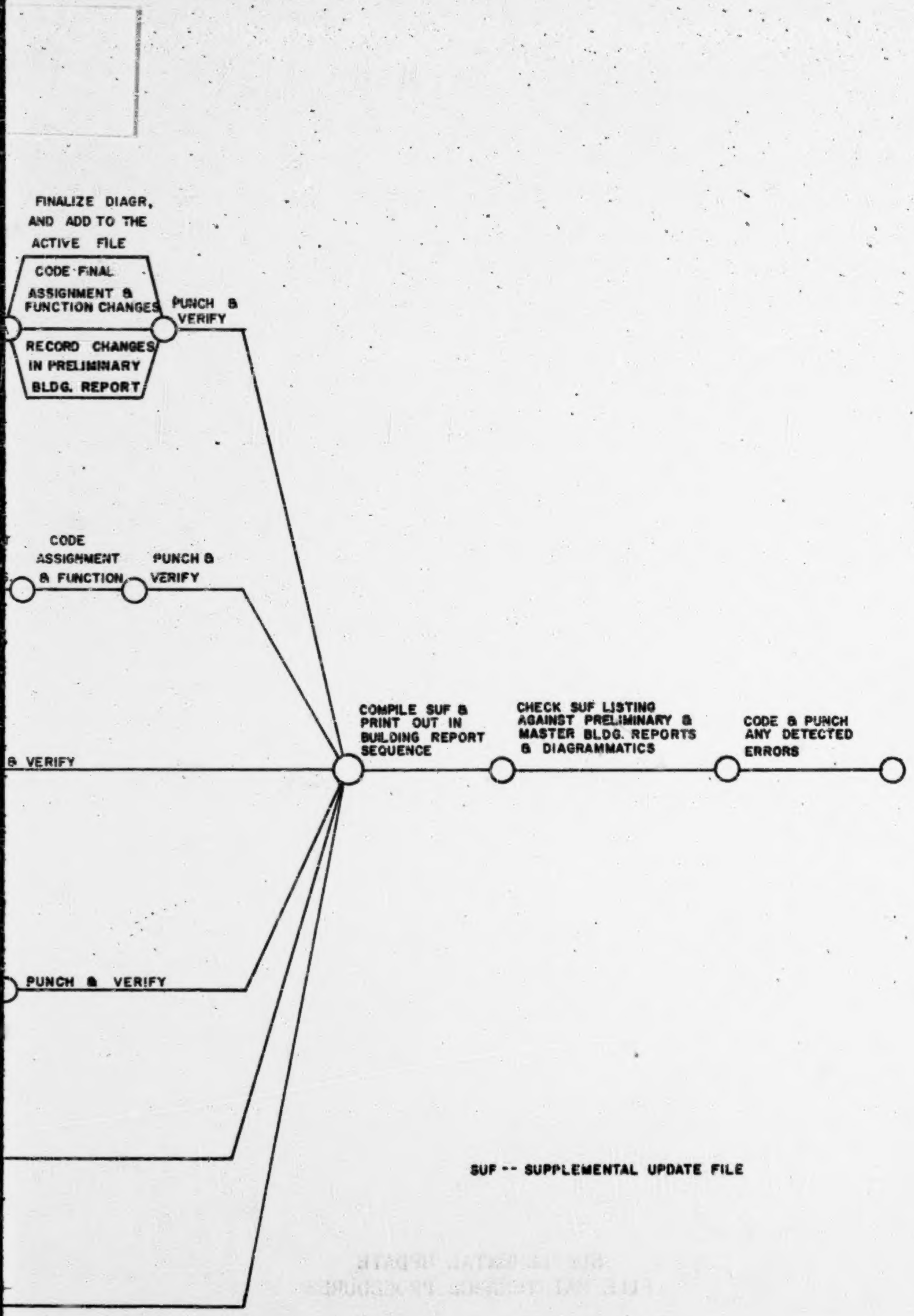
A perpetual space inventory requires that the master room inventory file reflect as nearly as possible the actual space situation at any point in time. The supplemental update allows the space office to keep the file current with regard to major changes while involving a minimum number of persons from the outside. However, some changes may not come to the attention of the space office through the supplemental update. Therefore, an institution-wide update is required periodically at which time departmental space representatives are asked to assist in correcting the space inventory. Since institutions are generally concerned with the reporting of their physical facilities and room utilization on an annual basis, such an institutional update may be conducted over the early months of the fall. By applying the techniques identified above, it is expected that a space office can maintain the master room inventory file in a reasonably current form.

Supplemental Update

Additions of space reflecting new construction, acquisitions and new leases; deletions of space reflecting razings and cancelled leases; and changes in the space reflecting remodelings, major reassignments of space and the correction of errors are effected by means of the supplemental update. The procedures for maintaining the master room inventory file by this method are shown in the form of a network on page A-59 to which either PERT or CPM techniques may be applied. It is assumed that the file maintenance would begin immediately after the institutional update has been completed. The seven branches of the network are discussed in the following pages.

SUPPLEMENTAL UPDATE FILE MAINTENANCE PROCEDURES


RECEIVE NOTIFICATION OF APPROVED NEW CONSTRUCTION
DEVELOP & APPROVE A RM. # SCHEME ON PRELIMINARIES
RECEIVE CONSTRUCTION DOCUMENTS
DRAW & DISTRIBUTE PRELIMINARY DIAGRAM.
PERFORM TAKE-OFF
CODE PRELIM. ASSIGN. & FUNCT.
OBTAIN BLDG. CODE & ADD TO BLDG. CODE LIST
PRODUCE PRELIM. BLDG., DEPT., AND CATEGORY REPORTS
RECEIVE CHANGE ORDERS
APPROVE ASSIGN & FUNCTIONS
CONDUCT ON SITE INSPECTION
NEW CONSTRUCTION
RECEIVE A COPY OF CLOSING STATEMENT
MAKE ON SITE VISITATION TO SKETCH FLOOR PLANS & TO DETERMINE CONDITION & APPROXIMATE AREA
APPROVE FOR RAZING (NO FURTHER WORK)
APPROVE FOR OCCUPANCY
OBTAIN BLDG. CODE & ADD TO BLDG. CODE LIST
DEVISE A RM. # SCHEME
DRAW DIAGRAMMATICS
PERFORM PHYSICAL INVENTORY
APPROVE ASSIGNMENT FOR SPACE REQUESTS RECEIVED FROM DEPTS
ACQUISITIONS
OBTAIN PLANS
GAIN APPROVAL FOR LEASING
NEW LEASES
RECEIVE ESTIMATED DATE OF RAZING OR CANCELLATION OF LEASE
REMOVE DIAGRAMMATICS FROM ACTIVE FILE
CODE DELETE FORMS
RECORD IN MASTER BUILDING REPORT
REMOVE FROM BUILDING CODE LIST
PUNCH
RAZINGS OR CANCELLED LEASES
RECEIVE REQUEST FOR REMODELING
OBTAIN ESTIMATED PROJECT COST
GAIN APPROVAL FOR "MAJOR" REMODELING
APPROVE "MINOR" REMODELING
DEVELOP & APPROVE A RM. # SCHEME ON PRELIMINARIES
RECEIVE PLANS
RECEIVE CONSTRUCTION DOCUMENTS
APPROVE RENUMBERING
DRAW DIAGRAMMATICS
PERFORM TAKE-OFF
CONDUCT ON SITE INSPECTION
RECORD CHANGES IN THE MASTER BLDG. REPORT
CODE FINAL ASSIGNMENT & FUNCTION
REMODELINGS
APPROVE DEPARTMENTAL REQUESTS FOR REASSIGNMENT OF SPACE
SEND LETTER OF ASSIGNMENT TO DEPT. WITH A COPY TO THE INVENTORY PERSONNEL
RECORD CHANGES IN THE MASTER BLDG. REPORT
CODE RESULTING ASSIGNMENT & FUNCTION CHANGES
PUNCH & VERIFY
REASSIGNMENT
RECEIVE NOTIFICATION OF SUSPECTED ERRORS
CORRECT DIAGRAMMATICS
CODE RESULTING CHANGES
RECORD RESULTING CHANGES IN THE MASTER BLDG. REPORT
PUNCH & VERIFY
CORRECTIONS


FINALIZE DIAGR, AND ADD TO THE ACTIVE FILE
CODE FINAL ASSIGNMENT & FUNCTION CHANGES
RECORD CHANGES IN PRELIMINARY BLDG. REPORT
PUNCH & VERIFY
CODE ASSIGNMENT & FUNCTION
PUNCH & VERIFY
& VERIFY
COMPILE SUF & PRINT OUT IN BUILDING REPORT SEQUENCE
CHECK SUF LISTING AGAINST PRELIMINARY & MASTER BLDG. REPORTS & DIAGRAMMATICS
CODE & PUNCH ANY DETECTED ERRORS
PUNCH & VERIFY

SUF -- SUPPLEMENTAL UPDATE FILE

New Construction: The space office should be provided a listing of all approved building projects with the approximate net assignable, net and gross figures set forth for each project. The anticipated dates of completion of these projects must be shown, as well. The usual confusion between the architect's room numbers and the institution's room numbers can be eliminated by requiring the architect to designate the rooms with the institution's numbers on the construction drawings. Thus, the space office can perform a scaling of the construction documents using the assigned room numbers which will remain virtually unchanged after occupancy.

When construction drawings are in hand for a new building, space office personnel can perform a take-off to determine the areas of all rooms and spaces and the gross area of the building. At this time room dimensions and actual area figures for non-rectangular spaces, as well as available preliminary assignment and room use information may be recorded on room inventory data sheets. Preliminary floor plan diagrammatic tracings should be developed for the building for reproduction and dissemination if they are not provided by the architect. The code and name of the new building must be secured from the campus agency which designates new buildings for the institution's accounting code manual.

When the room inventory data sheets have been completed for all spaces in approved buildings the data may be keypunched on cards and read onto tape for the purpose of generating supplemental reports of the anticipated space by building, department, and space category. If their volume is not great, the data may be processed manually from the room inventory data sheets in the desired formats. In either event, the data are to be maintained as a separate record and are not to be added to the master room inventory file at this stage.

As the building construction progresses, change orders affecting the physical layout of the building should be filed with the space office so that changes can be effected on the floor plan diagrammatics and in the preliminary inventory of the building spaces. Additionally, as room assignments are finalized and room uses fixed, the file should be updated accordingly.

As buildings are completed, inventory workers should make on-site inspections to assure that the floor plan diagrammatics and preliminary data are correct. It is suggested that the architect be required to furnish small-scale as-built drawings for each new building. If such drawings are not forthcoming from the architect, then some agency on the campus must be made responsible for developing building sets of floor plan diagrammatics.

Acquisitions: When buildings are acquired by the institution the space office should receive notification through some formal statement. An on-site inspection may be required to establish whether or not the space is usable and can be assigned to institutional functions. If it is judged to be non-usable it should be scheduled for razing and no further action need be taken by the space office. If, at the time of the on-site inspection, the space is judged to be usable, its general condition should be assessed and noted, sketches of the floor layouts made, and the approximate square footage determined. If the space is to be assigned in its acquired condition, then the space office should develop the required floor plan diagrammatics for the building, establish the room numbering scheme, measure the rooms, and identify the assignment and functional use of each room. A room inventory data sheet needs to be completed for each space and the data keypunched on cards and stored in the supplemental update file.

New Leases: If existing facilities are insufficient to fill the requests for space, it may be necessary for an institution to lease space. When a lease has been approved the rooms must be physically inventoried according to the procedures outlined above for acquisitions.

Razings: When a building is scheduled and approved for razing the space office should receive formal notice of the estimated date of the razing. At the time the razing is actually underway, the rooms involved should be coded on updating forms as deletions and the data keypunched on cards and stored in the supplemental update file. At this time the floor plan diagrammatics for the building should be placed in an inactive file.

Cancelled Leases: If leases are handled within the space office, then the person responsible for them must notify the inventory personnel when a cancellation occurs. At such time these rooms are also to be coded on updating forms as deletions and the data keypunched on cards and stored in the supplemental update file. Floor plan diagrammatics for the buildings in question should be placed in the inactive file.

Remodelings: When a remodeling has been approved, the space office should receive a copy of the remodeling plans for the purpose of reviewing the renumbering scheme. The rooms involved must be scaled and the respective floor plan diagrammatic tracings revised. An on-site inspection should be made to insure that the completed remodeling was carried out in accordance with the plans. At this point changes in the assignment and functional use can be coded and the resulting cards added to the supplemental update file.

Reassignment of Space: When a space is reassigned, information relative to the change must be registered with the inventory personnel. For file maintenance purposes, the respective room records must be updated to reflect changes resulting from reassignments and the data incorporated in the supplemental update file.

Correction of Errors: Inasmuch as some percentage of error will be inherent in the master room inventory file, persons working with the inventory data (both inside and outside the space office) should be requested to report any obvious or suspected errors to the space office. These should be noted and checked by the inventory personnel.

Institutional Update

The supplemental update file discussed in the preceding pages should contain a record of the majority of changes which have occurred in the institutional space. However, changes may take place which are not reported to the space office; e.g., the sharing or exchange of rooms between departments as well as changes in room use. The institutional update is intended to enlist the aid of departmental space representatives at prescribed intervals in bringing such changes to light, so that the master room inventory file may be kept current. Such an update should precede the processing of the total file for planning or reporting purposes and should be conducted at least once a year. A network presentation of the institutional update is presented on page A-63.

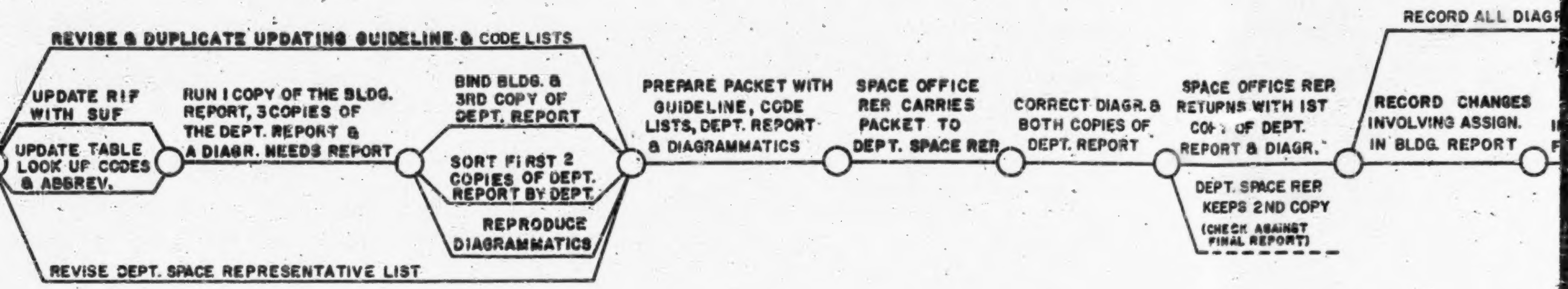
The initial step in this technique is to update the master room inventory file with the data accumulated in the supplemental update file. Following this update, one copy of the space inventory report by building should be run. This report must be checked against the previous record and further clean-up of the room inventory file effected if required. When the room inventory file has been fully updated, one copy of the space inventory report by building should be printed out and bound for space office use during the update. The space inventory report by department may be printed out on three-part paper at this time. In the bursting process the first two copies, with carbon insertions, should be kept in loose form for later dissemination to departments. The third copy may be assembled and bound for internal use. In addition, a diagrammatic needs report must be generated listing all departments by floor level within building, and the required quantity of floor plan diagrammatics produced for each floor.

INSTITUTIONAL UPDATE
FILE MAINTENANCE PROCEDURES

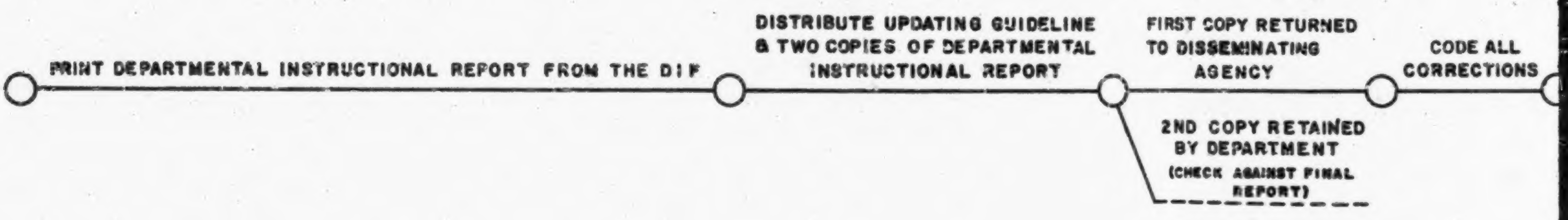
A-63

INSTITUTIONAL UPDATE

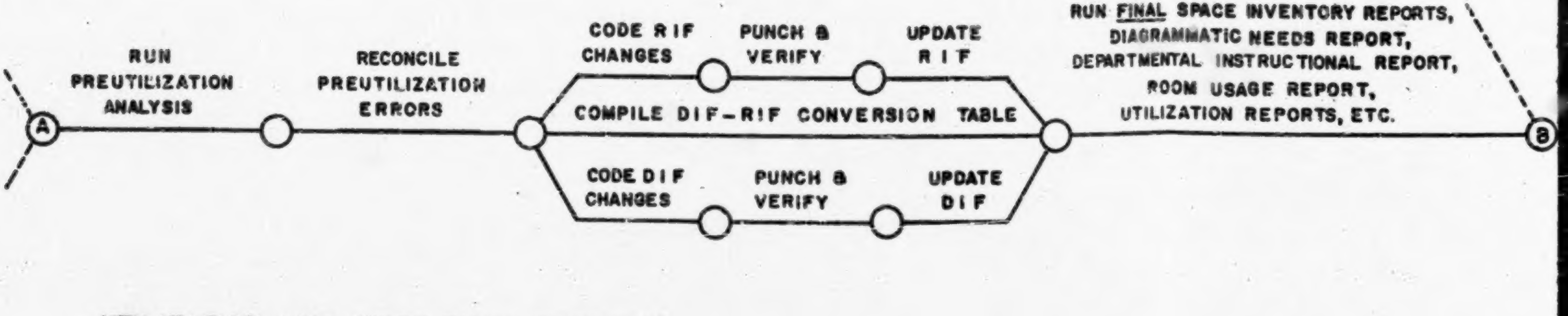
FILE MAINTENANCE PROCEDURES


REVISE & DUPLICATE UPDATING GUIDELINE & CODE LISTS
UPDATE RIF WITH SUF
UPDATE TABLE LOOK UP CODES & ABBREV.
RUN 1 COPY OF THE BLDG. REPORT, 3 COPIES OF THE DEPT. REPORT & A DIAGR. NEEDS REPORT
BIND BLDG. & 3RD COPY OF DEPT. REPORT
SORT FIRST 2 COPIES OF DEPT. REPORT BY DEPT.
REPRODUCE DIAGRAMMATICS
REVISE DEPT. SPACE REPRESENTATIVE LIST
PREPARE PACKET WITH GUIDELINE, CODE LISTS, DEPT. REPORT & DIAGRAMMATICS
SPACE OFFICE REP. CARRIES PACKET TO DEPT. SPACE REP.
CORRECT DIAGR. & BOTH COPIES OF DEPT. REPORT
SPACE OFFICE REP. RETURNS WITH 1ST COPY OF DEPT. REPORT & DIAGR.
DEPT. SPACE REP. KEEPS 2ND COPY (CHECK AGAINST FINAL REPORT)
RECORD ALL DIAGR
RECORD CHANGES INVOLVING ASSIGN. IN BLDG. REPORT

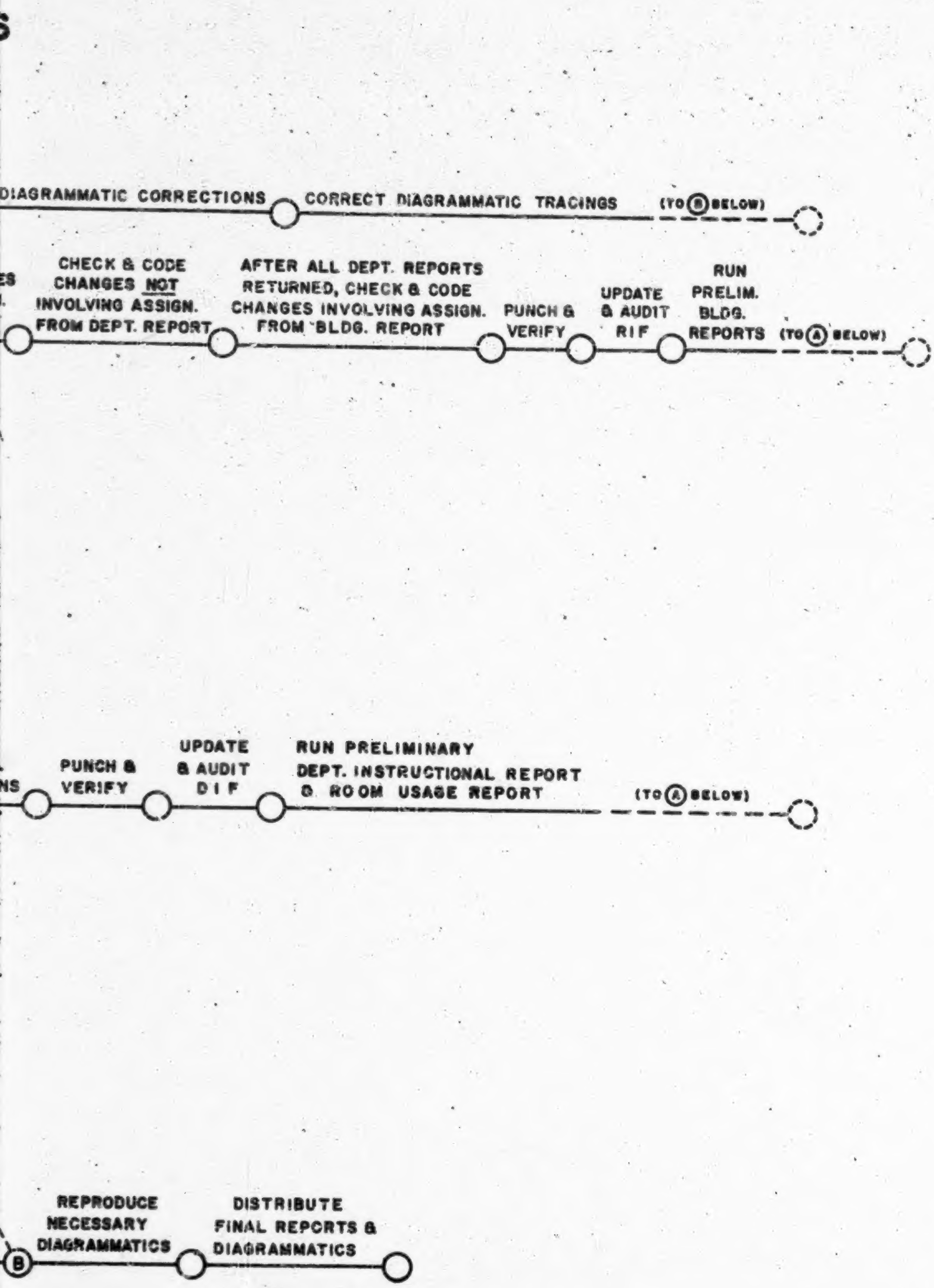
ROOM INVENTORY FILE (RIF)


PRINT DEPARTMENTAL INSTRUCTIONAL REPORT FROM THE DIF
DISTRIBUTE UPDATING GUIDELINE & TWO COPIES OF DEPARTMENTAL INSTRUCTIONAL REPORT
FIRST COPY RETURNED TO DISSEMINATING AGENCY
2ND COPY RETAINED BY DEPARTMENT (CHECK AGAINST FINAL REPORT)
CODE ALL CORRECTIONS

DEPARTMENTAL INSTRUCTIONAL FILE (DIF)


A
RUN PREUTILIZATION ANALYSIS
RECONCILE PREUTILIZATION ERRORS
CODE RIF CHANGES
PUNCH & VERIFY
UPDATE RIF
COMPILE DIF-RIF CONVERSION TABLE
CODE DIF CHANGES
PUNCH & VERIFY
UPDATE DIF
RUN FINAL SPACE INVENTORY REPORTS, DIAGRAMMATIC NEEDS REPORT, DEPARTMENTAL INSTRUCTIONAL REPORT, ROOM USAGE REPORT, UTILIZATION REPORTS, ETC.
B

UTILIZATION AND OTHER FINAL REPORTS

S
DIAGRAMMATIC CORRECTIONS
CORRECT DIAGRAMMATIC TRACINGS
(TO Ⓑ BELOW)
ES
CHECK & CODE CHANGES NOT INVOLVING ASSIGN. FROM DEPT. REPORT
AFTER ALL DEPT. REPORTS RETURNED, CHECK & CODE CHANGES INVOLVING ASSIGN. FROM BLDG. REPORT
PUNCH & VERIFY
UPDATE & AUDIT RIF
RUN PRELIM. BLDG. REPORTS
(TO Ⓐ BELOW)
NS
PUNCH & VERIFY
UPDATE & AUDIT DIF
RUN PRELIMINARY DEPT. INSTRUCTIONAL REPORT & ROOM USAGE REPORT
(TO Ⓐ BELOW)
B
REPRODUCE NECESSARY DIAGRAMMATICS
DISTRIBUTE FINAL REPORTS & DIAGRAMMATICS

The first and second copies of the inventory report by department and the appropriate floor plan diagrammatics may be collated for each department at this time. During this period the code lists and the guide for updating the space inventory by department should be revised if necessary and duplicated in sufficient quantity. The list of departmental space representatives must be brought up-to-date showing the name, title, office address and telephone number of each individual appointed to represent a specific department in matters relating to space. Envelopes designated by department name and code should be stuffed with two copies of the space inventory print out by department, the appropriate floor plan diagrammatics, the code lists, space classification chart, space category definitions, and instructions for updating the space inventory report by department. The guide for updating the space inventory report by department is shown on page A-65.

It is recommended that space office personnel hand carry the inventory packets to the departments and assist the departmental space representatives in updating the print outs and related floor plan diagrammatics. (In the case study the packets were divided among the inventory workers who set up appointments with the respective departmental representatives for the purpose of expediting the update. As a result, the task was accomplished in a period of about a month. It is quite certain that an update by mail would have required a period several times as long. It is also believed that the personal contact and assistance contributed significantly to the accuracy of the data.) The original copy of the updated inventory print out and the floor plan diagrammatics must be returned to the space office. The carbon copy is to be retained by the department and used as a check against the final corrected report of the department's space.

Changes involving the assignment must be recorded in the space inventory report by building and should not be coded until all departmental print outs have been returned. When assignment changes for all departments have been recorded in this report, a check must be made to assure that each space is assigned to a specific department or, if assigned to two or more departments, that the percentages of the prorations reported add up to 100 percent. When all discrepancies have been corrected, these changes can be coded from the space inventory report by building.

Changes other than those involving assignment should be coded directly from the updated departmental space print outs. Prorations based on functional uses of a room must be checked to assure that they equal 100 percent.

When all corrections and changes have been coded, the data should be keypunched on cards and incorporated into the master room inventory file. At this juncture, corrected reports of the space inventory can be run by building, department, space category, etc. (If a utilization study is conducted, additional corrections of the room inventory file may be necessitated.)

When the inventory reports have been generated and corrected floor plan diagrammatics have been produced, each department should be sent a copy of its space inventory and a set of the appropriate floor plan diagrammatics. Reports are to be run in such quantity as will satisfy the institution's needs and should be supplied to the campus agencies which have need for the inventory data.

Guide for Updating Space Inventory Report by Department:

1. General Instructions -- Your departmental space inventory report is to be corrected and the original returned to the Space Management Office at 606 State Street. The carbon copy is for your file. All corrections and additions are to be made legibly and should reflect the assignment and functional use of the rooms as of October 1. Scan the print out line by line for incorrect items. Cross out any item which is incorrectly reported and write or type in the corrections. Additions or corrections requiring more space should be made on the blank page provided at the end of your report. Check off on the floor plan diagrammatics all rooms assigned to your department as they appear in the updated space inventory report. Question mark any room which appears to be incorrectly drawn, and indicate the correction required.

2. Specific Instructions -- Check each column of the print out from left to right treating the items in the following manner:

   a. Building Code and Abbreviation -- these two columns contain a four digit building code and an abbreviation of the building name. Check these against the Building Code List to assure that the proper building is designated on your report.

   b. Floor Level -- check this number against the corresponding floor plan diagrammatics and notate on the report if it appears to be in error.

c. Room Number -- check the number against the appropriate floor plan diagrammatic and notate on the report any questions relating to room designation.

d. Card Number and Serial Number -- disregard these two columns as they are set up for internal purposes only.

e. Total Area -- the floor area of the entire room. Note any questions.

f. Prorate -- the percentage of the room given to the department and space classification indicated. Under this column heading 1.00 is to be interpreted as 100%. Percent prorations should be shown for the following: (1) rooms having two or more space classifications; (2) rooms shared by two or more departments; or (3) a combination of the foregoing. Prorations are not justified unless the amount of area in each instance is expected to be a significant fraction of the total area of the room. The total of all the prorations for a room must equal 100%. If a room is assigned to two or more departments it is assumed that the prorations indicated will be based on agreement reached by the departments concerned.

   If a proration is necessary, only the following items are to be written in for each proration: (1) percentage of the proration; (2) number of stations, if required (see item h); (3) division-department code number; (4) department abbreviation; (5) space classification code numbers; (6) category abbreviation or name; and (7) room type abbreviation or name.

g. Prorated Area -- the floor area of the prorated portion of the room obtained by multiplying the total area by the decimal fraction of proration. The computer makes this calculation.

h. Number of Stations -- the actual number of existing stations in the room as of the time of this updating. Every station figure should represent the number of persons -- either students or staff, according to the type of room -- that may be accommodated in the room at one time. Separate station counts may be necessary for each prorated portion of a room.

A station count is required for all rooms classified in the categories or by the room types listed below, whether or not a count is shown in the report.

Categories

010	Classroom
020	Instructional Laboratory
102	Research Laboratory

Room Types

520	Faculty Office
522	Civil Service Office
524	Graduate Assistant Office
526	Office-Studio
540	Conference Room
600	Auditorium
602	Theater
620	Study Room
640	Reading or Reference Room
642	Faculty Study
644	Carrel
704	Spectator Seating

(For easy reference, it may be helpful to underline the above category and room type codes on the space classification system code list.)

i. Division-Department Code and Department Abbreviation--these two columns contain a six digit code (the first two digits designating the division and the last four the department) and an abbreviation of the department name. Check this six digit code and the abbreviation against the division-department code list to assure that each room is properly assigned.

Cross out the entire line on the print out for any room which is not assigned to your department. For a room assigned to your department which does not appear on your report, write in all of the items on the blank sheet of paper supplied at the end of your report.

j. Space Classification Code, Category Abbreviation and Room Type Abbreviation -- these three columns contain a six digit code (the first three digits designate the category and the last three the room type) and the abbreviations of category and room type. Check these items against the Space Classification Code List to assure that each room is properly classified.

Corrections are to be made by crossing out the incorrect category or room type code and respective abbreviation and writing in the proper code and name. (Abbreviate names where necessary.) The proper category can be determined by referring to the list titled "Space Categories and Definitions." The correct room type can be determined by referring to the Space Classification Code List and selecting the type which most appropriately describes the use of the room.

k. Suite Identification -- all of the rooms comprising a particular suite will show the same alphabetic character in this column. A suite is defined as two or more rooms which are used as a single unit to accommodate a single functional use. The room designation for the suite which appears in the time-table will show the entire area and total station count for the suite while the other rooms involved will show asterisks (indicating magnitude) in the Area and Station columns. In this manner, the rooms comprising the suite will be specifically identified to provide a better record of instructional spaces and may not need to be used otherwise.

l. MAF Code -- this column is used to indicate the type of proration according to the following code: a one indicates that a room is assigned entirely to one department, but that it has two or more functional uses; a two indicates that a room is assigned to two or more departments, but has only one functional use; and a three indicates that a room is assigned to two or more departments and that it has two or more functional uses.

Thus, all portions of a room with a MAF code of one will appear on your report while only some of the prorations of a room with a MAF code of two or three will appear. Since this code is assigned by computer, it will not be necessary to indicate the type of proration on the report when corrections are made.

Computer Audits of Room Inventory File

Each time the master room inventory file is updated, computer audits of the card data should be made. The alternative method of manually checking the space inventory report for all errors requires many hours of effort and is much less accurate. The kinds of errors which may be uncovered by the computer audits are:

1. Missing or non-existent building code. (When the field calling for building code is blank or carries a code which is not valid.)
2. Missing floor level or room number. (When either of these fields are blank.)
3. Missing area. (When the field containing the total area of a room is blank. This may be due to the fact that no actual area figure was recorded or punched for a "non-rectangular space" and that a primary dimension was not recorded or punched for a "rectangular space.")
4. Missing dimension. (When one dimension of either the primary or secondary rectangle is missing for a "rectangular space" and the actual area is computed only on the basis of the one rectangle for which two dimensions are given.)
5. Excessive area. (When the area field contains a square footage figure greater than that established as maximal for the rooms in the inventory. Though some rooms may properly exceed this maximum, others may be detected which show excessive areas due to coding or keypunching errors.)
6. Total prorations of a room not equalling 100 percent. (When the sum of the prorations is less than or greater than 100 percent.)
7. Missing or non-existent division or department codes. (When fields calling for these codes are blank or the codes designated are not valid.)

8. Missing or non-existent space classification codes. (When fields calling for these codes are blank or the code recorded for a given category or room type is not valid.)

9. Non-assignable spaces reported as assignable. (When the space category indicates the space to be non-assignable but the division-department code reported is other than that set up for general building space.)

Errors such as those enumerated above should be corrected as promptly as possible. Since some of the errors will occur in additions to the file, the file should be re-sequenced with new serial numbers and a report of the space inventory by building printed out. The updating forms completed must carry the serial numbers shown in the new report.

Since some coding transpositions may result in code designations which are valid yet incorrect, a manual check of the report is necessary. In general, when coding data great care must be exercised to insure that existing errors will be corrected and that new errors will not be introduced into the master room inventory file.

APPENDIX B

THE SPACE UTILIZATION STUDY

Institutions of higher education have conducted space utilization studies for a period of years. Generally, these have been restricted to teaching facilities; essentially classrooms and instructional laboratories. Though such facilities may represent only 10 to 25 percent of an institution's space, they lend themselves to measurement and a study of the efficiency of their use is warranted. Teaching facilities relate directly to student enrollments and staff. If an institution is to carry out its basic charge -- the instruction of students -- the provision of these facilities must keep pace with the demand generated by the enrollments.

Purposes of the Utilization Study

When the levels of utilization of existing classrooms and instructional laboratories are determined and studied, in relation to utilization goals prescribed for an institution, a more valid assessment of current and future teaching space needs can be made. The measurement of the efficiency with which existing facilities are being used should provide a basis for determining how many additional students might be accommodated through improved scheduling practices. It should also aid in determining the number and size of additional rooms which may be required to properly accommodate future instructional programs.

Utilization Criteria

Space utilization studies seek to determine the levels at which rooms and student stations are being used. The criteria employed in the case study for measuring and expressing room utilization are set forth and defined below.

Section: a group of students assembled for instruction in the same subject at the same time in the same room.

Room Period: the unit of continuous time devoted to the instruction of a section; generally approximating one hour. For the purposes of this study a fifty minute class period was used. Periods greater in length were expressed in multiples of fifty minutes and additional minutes rounded off to the nearest half period. For example, three clock hours of continuous instruction were reported as three and one half room periods. (Methods of deriving room periods may differ significantly between institutions.)

Weekly Room Periods: the total number of room periods that a room is occupied by scheduled classes during the week, regardless of class size.

Student Contact Hour: one period of organized instruction involving one student. Total student contact hours for a section is the product of the number of students in the section and the weekly room periods of instruction for that section. (Numerically, student contact hours are equivalent to student stations used.)

Station: the facilities required to accommodate one person at a given time. In a classroom one chair or seat would constitute a student station. In a laboratory a station may consist of a clearly defined area of laboratory work table or a specific combination of work table area and equipment. In some shop-type laboratories and research facilities the number of persons that can be accommodated in the room at one time may need to be estimated in order to establish the number of stations for the room. For a laboratory comprised of a suite of rooms, the number of stations is based upon the total number of persons that can be accommodated in the several rooms at one time and the station count is attributed to the total area of the suite. In an office one station may be comprised of a desk, a chair and various other office equipment.

Student Stations Available: the product of the number of stations contained in a room and the weekly room periods of use. For a category it would be a summation of the products for all of the rooms. (Student stations available may also be computed on the basis of a weekly room period standard or the full scheduling week; however, experience has shown these to be of little value.)

Full Time Equivalent Room: an individual room or a composite of the prorated portions of two or more rooms which may be scheduled for instruction 100 percent of the time. (A suite of rooms used as a unit is treated as an individual room.)

Average Weekly Room Periods: the average of the room period use for a given space category obtained by dividing the total number of full time equivalent rooms into the total number of weekly room periods.

Student Station Utilization Rate: the percentage of student stations available which are occupied while the room is in use, obtained by dividing total student stations available into the actual number of student stations used; the latter being numerically equivalent to the total student contact hours for the room. (This measure may be computed for a section, room, or category.)

Square Feet Per Student Contact Hour: the unit area per contact hour derived by dividing the total student contact hours into the total area. (this may be computed on a room or category basis.)

Square Feet Per Student Station: the unit area per student station obtained by dividing the total stations into the total area. (This may be computed on a room or category basis.)

Utilization Goals

Standards of utilization -- which should be viewed as goals -- need to be established by an institution for both classrooms and instructional laboratories. Such goals can be useful in determining the number and size of future teaching spaces. (At the case study institution these standards are 30 average weekly room periods of use with 67 percent station utilization for classrooms, and 24 average weekly room periods of use with 80 percent station utilization for instructional laboratories.) The goals should be derived from a careful analysis of the curricular structure and class size distribution.

Conducting the Space Utilization Study

In performing a utilization study, the master room inventory file must be brought up-to-date through an institutional update as described in Appendix A. It is imperative that the file contain the following information for each classroom and instructional laboratory: (a) room number; (b) building code; (c) area of room; (d) student station capacity and (e) space category. In addition to the master room inventory file, it is necessary to construct an instructional file containing the following information for each section: (a) department in which course is taught; (b) course number; (c) section number; (d) type of instruction; (e) time of section meeting; (f) days of section meeting; (g) location of section meeting; and (h) number of weeks that the course is taught. The data in the master room inventory file and the instructional file are merged on the basis of room number and building code in generating the utilization report.

The Departmental Instructional File

For the purposes of a utilization study, the instructional data may be derived from: (a) student registration records or (b) an expanded timetable updated by the teaching departments. Inasmuch as the case study institution was in the process of computerizing timetable construction and student scheduling, the expanded timetable approach was applied in collecting the instructional data. The expanded and corrected timetable is referred to as the departmental instructional file and the tape layout of this file is described below.

College Code: a single digit code designation for the college in which the course is offered. (This code was different than that used for designating divisions in the physical facilities inventory system.)

Course Number: a seven digit number in three parts. It is comprised of a three digit code designation for the department in which the course is taught, a three digit number identifying the course, and a single digit number assigned to each combination of a department code and course number, for the purpose of a parity check. (Since this department code was established specifically for the timetable, it is different than that used for designating the department in the physical facilities inventory system.)

Section Number: a one to three digit number identifying the subdivisions of a particular course.

Type of Instruction: a single letter alpha code identifying the type of instruction for the section; e.g., L -- Lecture, A -- Lab, Q -- Quiz, etc.

Begin Time and End Time: a begin time for the section and an end time if a section is other than 50 minutes in length. (All times were recorded in this file on the basis of a 24 hour clock. However, the various reports and the timetable employed a 12 hour clock for the convenience of users.)

Days: the days on which the section meets.

Meeting Place: the room number and code for the building in which the section is taught.

Varying Time or Location of Meeting: an additional record for a section having irregular meeting times or meeting in different rooms during the week.

Section Enrollment: the number of students enrolled in the section. (In the case study these were enrollments as of October 1 since the utilization study was based on the fall semester.)

Instructor Information: the name, rank and employee number (from payroll records) of the instructor for the section. When two or more persons shared in the instruction of a section, this information was recorded for each instructor.

Cross-listed Course Designation: the designation of a course listed in two or more departments. A primary code was assigned to the course in the department which had major responsibility for and control over the course and a secondary code was assigned to the listings of that course in other departments. This allowed for the course data to be incorporated only once in the utilization study by including only the listing having the primary code designation.

Course Duration: the length of time in weeks that the course is taught. Courses other than a semester in length were adjusted for inclusion in the utilization study by multiplying the weekly room periods and the ratio of the course duration to 18, the number of weeks in a semester.

Collecting the Instructional Data

A preliminary departmental instructional file should be generated reflecting the available timetable information. This file needs to be expanded and corrected since it does not contain any enrollment data and may not be totally correct due to changes in room assignment, time, sections added or dropped, etc.

Two copies of the departmental instructional report should be printed out with carbon inserts and disseminated to departments for completion and correction along with instructions for updating the report. A sample copy of the departmental instructional report is shown on page B-6. The original copy of the updated print out should be returned to the agency responsible for the development of the departmental instructional file. The second copy should be retained by the department and used as a check against the final print out generated from the updated departmental instructional file.

It is recommended that personnel working with the instructional data carry the print outs to the departments rather than to disseminate them by mail. This provision of direct assistance will expedite the task and result in a more complete and accurate record of instruction. Specific instructions for updating the departmental instructional report follow:

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                                        DEPARTMENTAL  INSTRUCTIONAL  REPORT                              FINAL COPY
                                              F A L L     1 9 6 5

                             DEPARTMENT  PSYCHOLOGY          -CONT-

COURSE           DESCRIPTION       TYPE    SEC BEG  END  DAYS  ROOM  BUILDING  DR     INSTRUCTOR        RANK    EMP NO  ENR   SER  N
820 285 5.HONORS CRSE-EXP PSYCHOLOGY. DISC      . 330  420. T    . 126  PSYCHOLOGY.18.CALFEE, ROBERT C   .AST PROF.126900.  12.  9325
         .                         .            .        .       .                 . .                  .        .      .
         .                         . LAB       .700  1000. T    . 136  PSYCHOLOGY.18.CHASE, WILLIAM G   .T.A.     .139595.  12.  9326
         .                         .            .        .       .                 . .                  .        .      .
820 314 3.INDUSTRIAL PSYCHOLOGY    . LECTURE   .1100 1150.M W F . 103  PSYCHOLOGY.18.SMITH, KARL U     .PROF     .832030.  70.  9327
         .                         .            .        .       .                 . .                  .        .      .
820 325 9.EXP PSYCH FOR GRAD STUDENT. LECTURE  2. 955 1045.M W F . 121  PSYCHOLOGY.18.THURLOW, WILLARD R .PROF     .896350.   2.  9332
         .                         .            .        .       .                 . .                  .        .      .
         .                         . LECTURE  5. 825  940. T T  . 121  PSYCHOLOGY.18.BROGDEN, WILFRED J .PROF     .103680.  38.  9335
         .                         .            .        .       .                 . .                  .        .      .
         .                         . DISC     5. 120  210.M     . 134  PSYCHOLOGY.18.MELAMED, LAWRENCE .T.A.     .578290.   2.  9340
         .                         .            .        .       .                 . .                  .        .      .
         .                         . DISC    10. 955 1045.    F . 130  PSYCHOLOGY.18.BOWMAN            .ASC PROF.091320.   1.  9345
         .                         .            .        .       .                 . .                  .        .      .
         .                         . DISC    11. 745  835. T    . 134  PSYCHOLOGY.18.BOWMAN            .ASC PROF.091320.   1.  9346
         .                         .            .        .       .                 . .                  .        .      .
         .                         . DISC    14. 330  420.M     . 134  PSYCHOLOGY.18.SCHWARTZ, MARIAN S .AST PROF.797930.   1.  9349
         .                         .            .        .       .                 . .                  .        .      .
         .                         . DISC    17. 120  210. T    . 130  PSYCHOLOGY.18.BROGDEN, WILFRED J .PROF     .103680.   3.  9352
         .                         .            .        .       .                 . .                  .        .      .
         .                         . LAB      5. 745  940.M     . 138  PSYCHOLOGY.18.MELAMED, LAWRENCE .T.A.     .578290.   2.  9360
         .                         .            .        .       .                 . .                  .        .      .
         .                         . LAB     10. 955 1150. T    . 138  PSYCHOLOGY.18.BOWMAN            .ASC PROF.091320.   1.  9365
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Guide for Updating Departmental Instructional Report: Your departmental instructional report is to be updated and returned to the Scheduling Division -- Office of the Registrar by October 22. The duplicate copy is for your file. All corrections and additions are to be made legibly with a pencil or typewriter. Please follow the specific directions given below.

1. Use information from your records as of October 1.

2. Scan print out line by line for corrections of items shown. Cross out any item which is incorrectly reported and write or type correction directly above.

3. Cross out entire line of print out for each course or section dropped, cancelled, etc. No further action is required on these.

4. Check each column of the print out from left to right to assure that the following items are printed out and correct:

    a. Course number -- the full seven digit number assigned to the course.
    b. Description -- the descriptive name of the course.
    c. Type -- the type of instruction: Lecture, Lab, Quiz, etc.
    d. Section -- the number of the section.
    e. Begin time -- the begin time of the section.
    f. End time -- the end time of the section if it is other than 50 minutes in length.
    g. Days -- the days of the week on which the section is taught.
    h. Room -- the number designating the room in which the section is taught.
    i. Building -- the name of the building in which the room is located.
    j. Duration -- the number of weeks a section is taught. (All courses and sections not shown in the listing which are other than a semester in duration are to be reported on the blank print out sheets provided. Indicate number of weeks in the duration column and estimate enrollments if necessary.)

5. The blank columns of the print out must be filled in accurately from departmental records as follows:

a. Instructor -- the surname and initials of the contact instructor for the section.
b. Rank -- the university rank of the contact instructor.
c. Employee No. -- the payroll account number of the contact instructor.
d. Enrollment -- the enrollment in the section as of October 1.

6. The column containing the serial number is to be disregarded inasmuch as it is assigned for data control purposes only.

7. You will note that evening classes are designated by an asterisk after begin time on the print out. Follow the same procedure when reporting additional evening classes.

8. If a course is associated with two or more departments (multiple-listed) indicate this fact in a footnote and show the numbers of the courses with which it is cross-listed. When listing such a course do not divide the enrollment between departments but report all students in the group under one course number.

9. If a section meets in two or more different rooms during the week or at two or more unique times, the additional begin time, end time, days, room and building information should be shown on the line(s) below the original listing of the section. All other information should be shown in the original listing.

10. In some cases two or more rooms may be assigned as a unit for use in a specific course or courses. Where such group assignment of rooms is uniform for all courses assigned to the suite, the rooms are to be considered a single unit and identified by the number shown in the timetable as representative of the suite arrangement. The number(s) of the other room(s), however, must be noted.

11. New courses, as well as courses not shown in the listing which are other than a full semester in duration, must be recorded on the blank sheets of print out paper supplied at the end of the report. (Additional sheets may be secured by calling the telephone number shown below.) Record all added or new information for one course before listing the next one. Use a separate line for each section. Leave space between sections as you make entries.

Use a separate line for each instructor for thesis, independent study courses, and special problems courses.

If you have scheduled weekly meetings of groups of students engaged in independent study or research, special problems courses, etc., report these meetings in all details as an organized class, making certain that room number and building are given.

12. Please return the updated report by October 22 with complete information on all scheduled sections inasmuch as the data are necessary for the generation of a room and student station utilization report.

If you have any questions regarding the updating of this report feel free to call our office (Telephone 262-3258).

We will supply each department chairman with a final corrected copy of his departmental instructional report. Copies will be sent to the respective Deans and to the Secretary of the Faculty, as well.

Computer Audits of Departmental Instructional File: To insure that the data contained in the file are complete and correct, a number of computer audits can be made. These should test the following items for correctness.

1. The validity of the course number.
2. The begin time to determine if it is blank.
3. The begin time and end time to insure that both are numeric.
4. The day designation to assure that at least one day is shown.
5. The validity of the type of instruction.
6. The course duration for a positive non-zero number.
7. The section enrollment for a positive non-zero number.
8. The validity of the instructor's rank.
9. The meeting times, days, and locations as a check for sections which meet at the same time, on the same day, and in the same room.

The Pre-utilization Analysis: After the room inventory file and the departmental instructional file have undergone their individual audits, an analysis of the two files should be made to insure that the data which they contain are compatible; e.g., that:

1. Each room contained in the departmental instructional file is contained in the room inventory file.

2. Each room contained in the departmental instructional file carries a teaching category code as a part of its record in the room inventory file.

3. Each room having a teaching category code in the room inventory file is scheduled for instruction in the departmental instructional file.

4. The section enrollment reported does not exceed the total number of student stations for the room in which it is taught.

Any probable discrepencies or obvious errors pointed up by the analysis should be verified and the respective file or files updated. In the event of incompatibility of room and building designations, a table look-up may be constructed for the purpose of transcribing the room numbers and building codes contained in the room inventory file onto the departmental instructional file. (This problem may arise when timetable designations are different than the room inventory designations.) When the two files have been corrected and are compatible, final reports of each file can be run and the two files can be merged to generate a space utilization report.

The Utilization Report

The merged data of the room inventory file and the departmental instructional file are printed out on a room-by-room basis for each teaching space category. The room information is printed out across the top of the page and the section information below it. Room periods, student contact hours (equivalent to stations used), student stations available and percent of student station utilization are computed for each section and summed for the room. The student station utilization rate is computed for each room on the basis of the actual room periods of use. A sample page of the utilization report for the classroom category is shown on page B-11. A summation of full time equivalent rooms, area, student stations, student stations available, room periods and student contact hours is printed out on a summary page for each of the space categories in the utilization report. In addition, the area per station, area per contact hour, average weekly room periods and percent student station utilization are reported. A sample of the summary page for the classroom category is shown on page B-12.

The steps involved in conducting a space utilization study are set forth in the flow chart on page A-63. This chart shows the manner in which the systems of the inventory and the utilization study are integrated.

FIRST SEMESTER 1965-66

INSTITUTION NAME

10/31/65

ROOM UTILIZATION

CATEGORY ABBREV	BLDG CODE	BLDG ABBREV	FLOOR LEVEL	ROOM NO	PRO-RATE	PRO AREA	STUDENT STATIONS	DEPT ABBREV	SQ. FT./ STATION
CLASS RM	55	HIST	01	101	1.00	475	32	G A S	14.8

DEPT ABBREV	COURSE NO	SECT NO	TYPE INSTRUC	DAYS	TIMES BEGIN END	ROOM PERIODS	ENROL	CONTACT HOURS	STATIONS AVAIL	% STATION UTILIZATION
HISTORY	201	51	QUIZ	M	0745-0835	1.0	20	20.0	32.0	62.5
ILS	131	7	DISCUSSION	T T S	0745-0835	3.0	22	66.0	96.0	68.8
ILS	131	3	DISCUSSION	M W F	0850-0940	3.0	21	63.0	96.0	65.6
FRENCH	101	5	LECTURE	MTWT	0955-1045	4.0	29	116.0	128.0	90.6
ENGLISH	211	32	DISCUSSION	M	1100-1150	1.0	20	20.0	32.0	62.5
PHM ADMN	911	1	SEMINAR	T	1100-1150	1.0	3	3.0	32.0	9.4
ENGLISH	109	7	DISCUSSION	M	1205-1255	1.0	23	23.0	32.0	71.9
HISTORY	115	5	QUIZ	T	1205-1255	1.0	20	20.0	32.0	62.5
HISTORY	119	1	QUIZ	T	1205-1255	1.0	25	25.0	32.0	78.1
HISTORY	120	1	QUIZ	F	1205-1255	1.0	23	23.0	32.0	71.9
ENGLISH	463	4	DISCUSSION	M	1320-1410	1.0	15	15.0	32.0	46.9
HISTORY	120	17	QUIZ	T	1320-1410	1.0	19	19.0	32.0	59.4
PHM ADMN	711	1	SEMINAR	T	1320-1515	2.5	2	5.0	80.0	6.3
CHEM	103	93	DISCUSSION	M W	1425-1515	2.0	19	38.0	64.0	59.4
HISTORY	120	18	QUIZ	T	1425-1515	1.0	18	18.0	32.0	56.3
HISTORY	115	8	QUIZ	T	1530-1620	1.0	23	23.0	32.0	71.9
ILS	131	10	DISCUSSION	M W F	1530-1620	3.0	22	66.0	96.0	68.8
			ROOM TOTALS			28.5		563.0	912.0	61.7

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FIRST SEMESTER 1965-66                INSTITUTION NAME                                              PAGE NO.  324
  10/31/65

                                     UTILIZATION SUMMARY

                                         CLASSROOMS

  TOTAL           TOTAL            TOTAL                    TOTAL                      TOTAL                    TOTAL
 FTE ROOMS        AREA        STUDENT STATIONS    STUDENT STATIONS AVAILABLE    WEEKLY ROOM PERIODS    STUDENT CONTACT HOURS

  323.0          201596            12865                  385372                      9675.5                  25199.5


SQ. FT./STUDENT STATION       SQ. FT./STUDENT CONTACT HOUR        AVERAGE WEEKLY ROOM PERIODS        %STUDENT STATION UTILIZATION

      15.67                              .80                               29.96                                65.39
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APPENDIX C

PROJECTIONS OF ENROLLMENT FOR CAMPUS PLANNING

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Institutional Studies
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Project Assistant
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Projection of the potential student population at a college or university is one of the prerequisites to planning campus development. Instructional workloads, the number of faculty required, and the physical plant and land requirements of an institution clearly are affected by the size of the student body which the institution undertakes to serve and by the total mission of the institution. Instructional workloads are a function of the level and distribution of student enrollments. The space required for instructional effort (general classrooms, laboratory-classrooms, laboratories, seminar rooms, studios, and instructional gymnasia) is tied to contact hours and not to number of credits carried. Thus there should be a student projection according to the number of contact hours in each course (subject) in the institution.

The amount of other types of space needed also is affected by the size of the student enrollment. Some of these types of space are office space, library space, research space, archive and research equipment storage, inactive space (such as space being remodeled), buildings and grounds service space, student service space, campus hospital and health facilities, gymnasium and field house seating, auditoriums, theatres, museums, and laboratory schools.

Since some types of space are related quite directly to the number of students, head count enrollment projections are necessary in addition to the contact hour type of projection. This would be true of space such as parking facilities, dining facilities, student service space, gymnasium and field house seating, and residential facilities.

If the projections of total students are to be most useful, it will be necessary to have those projections divided by sex, by single and married, by class, and by school or college.

For estimating research space needs, it is essential to have projections of graduate enrollments divided by department and lower level (pre-masters), upper level (pre-doctoral), and post-doctoral. It is important, too, that projections of FTE (full-time equivalent) students be made by level of student (lower level--freshmen and sophomores; upper level--juniors, seniors, and specials; graduate; and professional--law, medicine, veterinary medicine, etc. The number of staff and type of staff are related to FTE students by level.

It is assumed, for the purposes of this exposition, that the respective university or college has both short-range estimates and long-range projections of total enrollment available, with divisions of that enrollment by sex and by class (freshman, sophomore, junior, senior, special, graduate, and professional [law, medicine, veterinary medicine, etc.]). This type of projection must be institution or campus based since it will be dependent upon the aims and purposes set up by the institution, the long-range goals of the institution, and the ability of the institution or campus to attract students from a pool of potential college-going individuals.

Educational policy does not remain static, nor should it. Some of the areas in which there must be policy decisions prior to the institution making intelligent enrollment projections are:

1. Will the institution limit its enrollment, or is it committed to accept all individuals who meet certain general requirements? Will there be changes in admissions requirements?

2. Will there be a plan to change the "mix" of students by class level? Will the institution, for example, to greater degree than previously, concentrate on attracting a higher proportion of graduate students?

3. Will there be an effort to increase to a great degree the proportion of the institutional effort devoted to research activities?

4. Will there be new degree programs, disciplines, or fields of study added or abandoned over the forecast period?

5. Will there be changes in the geographic area from which the students come? Will students who are non-

residents of the state be accepted to a greater or lesser degree than in the past?

6. Can changes in the economic structure of the patronage area be anticipated?

7. Can changes in the types and numbers of institutions in the state and their influence on the enrollment in the particular institution be forecast?

8. Is there evidence that an increasing proportion of youth will be graduated from high school and that an increasing or decreasing proportion of high school graduates will seek to attend the particular institution? Will a higher proportion of students continue for post-baccalaureate or post-doctoral work?

One notes from these questions that the projection of enrollment is not merely a statistical problem. College enrollments are dependent upon a large number of complex factors some of which are quite difficult to analyze.

The General Projection of Enrollment

This report will not include the specific design for a global enrollment projection. The reader is referrred to Lins,[1] Methodology of Enrollment Projections for Colleges and Universities.

A design which has been found useful by many colleges and universities for long-range projection is to relate (ratio method) the high school graduates by sex of the patronage area to the institution's new freshman enrollment by sex for the following fall, and this over a period of about five years, to develop a trend relationship.

The high school graduates by sex are projected for the future as a base for the new freshman projection. The ratio of new freshmen by sex to the high school graduates by sex is then utilized in projecting the future new freshmen of the institution.

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[1] L. J. Lins. Methodology of Enrollment Projections for Colleges and Universities (1785 Massachusetts Avenue, N.W., Washington, D.C.: American Council on Education, March 1960), pp. ix + 67.

The second step is to project the total freshmen by sex. The total number of freshmen consists of the new freshmen plus the continuing and reentering freshmen and the students transferring as freshmen to the institution. The non-new freshmen can be estimated on the basis of the past experience relationship (ratio) of continuing, reentering, and transfer freshmen by sex to the total freshmen by sex in the immediately preceding year. The sum of the two groups then gives the projected size of the total freshman class by sex.

The third step is a cohort-survival technique based upon past experience of the survival by sex of freshmen to sophomores, of sophomores to juniors, and of juniors to seniors. The projection of special students will vary from institution to institution depending upon the types of students so classified. They may be primarily non-matriculated students at the freshman level or they may be primarily post-baccalaureate students not admitted to the graduate school.

In large institutions, the size of the graduate enrollment is to great degree a function of the size of the freshman enrollment and the size of grant and fellowship funds. This is due to the support afforded through teaching assistantships and the support through research assistantships and fellowships.

The Projection by School or College Within the Institution

It is assumed that the persons concerned with space projections will have available to them the long-range projections made by the institution, by sex and by class. These projections can be broken into college and school projections by class and sex within the institution as follows, where for men, for example:

(A) = the current year and (B) = four years previous, i.e., the fifth year of enrollment data of the past, and

X_{1m} = males in the class in the College of Letters and Science:

X_{2m} = males in the class in the College of Engineering;

.

.

.

.

X_{Nm} = males in the class in college N.

$X_{1m(A)}$ therefore is the males for the respective class in the College of Letters and Science in the current year.

Y_A = the male enrollment in the class for all colleges in year A and Y_B = the male enrollment in the class for all colleges four years previous.

The changing ratio of total enrollment for males by class by college then is determined according to the following formula, illustrated for the College of Letters and Science:

$$\frac{\frac{X_{1m(A)}}{Y_A} - \frac{X_{1m(B)}}{Y_B}}{4} = \text{acy or average change per year}$$

The average change per year then is applied to the current ratio to obtain the ratio for each year within the forecast period. For the first year for men by class in the College of Letters and Science the new ratio would be:

$$\frac{X_{1m(A)}}{Y_A} + 1\ (\text{acy})$$

For the second year, it would be:

$$\frac{X_{1m(A)}}{Y_A} + 2\ (\text{acy});\ \text{etc.}$$

These ratios then would be applied to the projected enrollment total by sex and class as projected by the institutuion for the respective year to arrive at the expected enrollment by college, by class, and by sex and adjusted in the summation of all colleges to arrive at the institutional projection of the total.

The table (Table I) developed then for each projected year would show the enrollment by class and sex, by college, as follows:

TABLE I

PROJECTED ENROLLMENT BY CLASS, BY SEX, BY COLLEGE
FIRST SEMESTER OF YEAR 19 -19

College	Freshman		Sophomore		Junior		.....		Graduate	
	M	W	M	W	M	W	M	W	M	W
Letters and Science										
Agriculture										
.										
.										
.										
College N										
TOTAL										

Each college or university, in analyzing trends, may find that the foregoing requires the introduction of judgmental factors and a changed procedure based upon policy decisions about relative growth of individual units of the institution. This is illustrated in Exhibit I, which gives the design for the 1974 projections for the Madison Campus of The University of Wisconsin. Exhibit I is to be found on page C-15 of this appendix.

Projection of Graduate Students

Since there is a relationship between the number of graduate students and the amount of staff and space required for each department, it is essential to project graduate students by department.

A doctoral candidate generally requires more research space for his doctoral work than does the masters candidate for his research work. Also, doctoral candidates generally are involved to greater degree in funded research than masters students are. Therefore, the departmental projection of graduate enrollment must be divided according to masters and according to doctoral candidates. It is essential also to survey the departments for the best data possible on postdoctoral researchers.

For the projection of graduate students, one surveys the current and past majors by department at the pre-masters and pre-doctoral levels. This survey should be by sex as illustrated in Table II

TABLE II

GRADUATE MAJORS BY DEPARTMENT
FIRST SEMESTER OF YEAR 19 -19

Major Field	Masters Candidates			Doctoral Candidates		
	M	W	Total	M	W	Total
Accounting	40	1	41	14	2	16
Actuarial Science	8	1	9	--	-	--
African Languages & Literature	2	1	3	3	-	3
Agricultural Economics	41	2	43	54	1	55
.						
.						
.						
Zoology	50	22	72	36	14	50

If the survey of a five-year period of majors shows no appreciable change in the ratio of men to women, in the ratio of masters to doctoral candidates, or in the proportion of graduate students by level enrolled in the various departments, the enumeration of total graduate students (without regard to sex) by level and department for the year just previous to the projection period can be used. If it were found that the ratio of men to women has changed appreciably, that the ratio of masters to doctoral candidates has changed, or that the proportion of students registered in the various departments has changed a great deal, a changing ratio (acy) will need to be developed and employed as was illustrated in the section, "The Projection by School or College Within the Institution"; the proportion then would be a departmental "acy" projection stratified by sex and by level of graduate student. This would be the same procedure as the illustration of males, by class, by college of the ". . . Projection by School or College . . ." section.

If it were found that there had been no appreciable change over time in the ratios of men to women, of masters to doctoral candidates, and of the proportions of graduate students registered by department, the procedure is a simple ratio procedure with the ratios developed on the basis of the distribution of graduate students by level and by department for the year immediately preceding the projection period. In this event, the total graduate enrollment of the year immediately preceding the projection period would be used as the base of the series of ratios:

Y_0 = total graduate enrollment;

X_{1m} = masters enrollment in department 1;

X_{1D} = doctoral enrollment in department 1;

.

.

.

X_{NM} = masters enrollment in department N;

X_{ND} = doctoral enrollment in department N.

The ratios for the year immediately preceding the forecast period then would be:

$$\frac{X_{1M}}{Y_0};\ \frac{X_{1D}}{Y_0};\ \ldots\ \frac{X_{NM}}{Y_0};\ \frac{X_{ND}}{Y_0}$$

These ratios then would be applied to the total graduate enrollment for the respective years of the projection period (Table I). These years are Y_1 = first year, Y_2 = second year; . . . Y_N = last year of the projection period.[2] For the first year, the projected enrollment by departments would be:

$$\frac{X_{1M}}{Y_0}\cdot Y_1;\ \frac{X_{1D}}{Y_0}\cdot Y_1;\ \ldots .\ \frac{X_{NM}}{Y_0}\cdot Y_1;\ \frac{X_{ND}}{Y_0}\cdot Y_1$$

This procedure provides, through summation, the total masters level students and the total doctoral level students for the institution.

Again, it is noted that a particular school or college may need to vary its projection technique from that above. In the projections for the Madison Campus of The University of Wisconsin an alternate method was used (See Exhibit II, page C-19, of this appendix).

Projection of Enrollment by Course

Course (subject) enrollments are related to the college and year (freshman, sophomore, etc.) of the students. Some institutions may find it desirable to break the relationship down to an even finer division, i.e., student classification (EE1, AMP1, PRC1, COM3, etc.). This would be true in institutions where there are a small number of colleges and schools and where students are classified into specific disciplines at the freshman level. In many institutions, however, most freshmen and sophomores are classified into very broad categories (general BA, general BS, General College, etc.) and these students do not major or transfer to a semi-professional college until the beginning of the junior year. This would be true, for example, of students transferring into the School of Education, School of Commerce, School of Pharmacy, etc., after a year or more required in a liberal arts college. Therefore, no finer breakdown than a college-class breakdown will be presented here.

The course enrollment and the number and variety of courses will be affected by the policy decisions of the institution as outlined in the introductory section of this report. However, for the purposes of the methodological procedure presented, it is assumed that the proportionate enrollment by course, by college and class level, as of the year prior to the projection period is indicative of the proportionate distribution by course, by college and class level, for the future. There will be changes in courses offered, some courses will be offered only once every two or three years, but it is reasonable to assume that students of respective colleges by class level will enroll in courses which require relatively the same types of facilities as are required at present. Also, since it is difficult, if not almost impossible, to anticipate changes over as much as a 10 to 20 year period in disciplines offered, it is advised that the projections be updated yearly.

Ordinarily, the enrollment projections will be for day students only. It is assumed, then that the facilities required for day students will also take care of the evening enrollment. Only in institutions having a larger evening program than day program, per hour, will it be necessary to project evening enrollments. It should be kept in mind, however, that even under the assumption of the facilities for day students taking care of the evening programs, certain special purpose classrooms may have to be developed for the evening program. If Extension classes meet on the campus and if the Extension students are not included in the regular enrollment projections, it will be necessary, too, to program space for the Extension instructional activities.

The basic format for the course enrollment projection is the tabulation of the number of students, in the first semester of the year immediately preceding the projection period, from each college by class level (LS1, COM3, ENG2, etc.) enrolled in the respective courses. A ratio is established between the course enrollment by respective class and college and the enrollment in the college for that class. The projected class enrollment by college for the respective year is multiplied by the ratio of the respective class-college enrollment in the course to the respective class-by-college enrollment for the year immediately preceding the projection year. The respective results of the multiplications are summed to arrive at the total course enrollment for the respective projection year. As indicated, first semester data would ordinarily be used since, in most institutions, the first semester or quarter enrollment is larger than any subsequent semester or quarter enrollment of the year. This assumes that first semester or quarter facilities will meet the needs, therefore, of any subsequent semester or quarter of the year.

The first step then is to secure current data on first semester course enrollment divided by class and college. This would be reported as follows:

TABLE III

COURSE ENROLLMENT BY CLASS AND COLLEGE
FIRST SEMESTER OF YEAR 19 -19

Department and Course	Freshman	Graduate
	L & S Agric...Pharm	L & S Agric...Pharm
Anthro 100		
Anthro 105		
.		
.		
.		
Zoology 961		

Step two is to develop the ratios between the respective class-college enrollments in the respective course and the respective class-college enrollments of the first semester of the year immediately preceding the projection period (Table I); for example, the L & S freshman enrollment in Anthro. 101÷ by the L & S freshman enrollment.

Step three is to apply the respective ratios by course developed in step two to the projected enrollments by class and college for year X. This will give the projected enrollment by class and college for the respective course in year X.

Step four is to sum the college enrollments for the respective class for the respective course.

Step five is to sum the course enrollments by class for the respective department.

The result of steps four and five will be a table of enrollments by class, by course, and by department as presented in Table IV for year X.

Projection of Contact Hours by Type of Facility

Table IV is the base for projecting contact hours in that it presents the total enrollment by course. The next step is to develop the contact hours generated by each course. For example, and hypothetically, Anthropology 100 is a three-credit course, with an enrollment of 300, broken into one lecture and 12 discussion-quiz sections. The lecture section meets twice a week for one hour, and each discussion-quiz section meets for one hour per week. There is generated by this course 600 student contact hours per week in lecture and 300 student contact hours per week in discussion-quiz.

The summation, by department, of the number of student contact hours by type of instructional facility gives the total contact hours by type facility for the department. The summation of the total contact hours by type of facility for all departments within the college gives the total contact hours by type of facility for the college, and the summation of the college contact hours by type of facility gives the total contact hours by type of facility for the campus.

Projection of Full-Time Equivalent (FTE) Students

The need for teaching staff for a department is a function of the students to be taught. Since the rank and type of instructor is dependent upon the level of students taught, it becomes necessary to develop FTE student counts by student level. Here again, the department is the basic unit.

Student level is defined as lower level (freshman-sophomore), upper level (junior, senior, and special), professional (law, medicine, etc.), and graduate. For the purposes of this report, the number of FTE students at the undergraduate and professional levels is defined as the number of credits carried per semester divided by 15. The number of FTE students at the graduate level is defined as the number of credits carried divided by eight. It is true that the normal load for graduate students is 9-12 credits for full residence. However, due to the numbers of students who have completed their course work and who are registered for only two credits of research while working on the dissertation, the average number of credits is reduced to eight. This will vary with institutions as will the number of credits used for full-time equivalency vary with the type of "turn-around" or academic calendar setup (semester vs. quarter).

The FTE students by course are computed, the FTE students by courses within the department are summed to give the FTE

TABLE IV

ENROLLMENT BY CLASS, DEPARTMENT, AND COURSE
FIRST SEMESTER 19 -19

Department and Course	Fresh.	Soph.	Jr.	Sr.	Spec.	Grad.	Law	Med. ...	Total
Anthropology 100									
Anthropology 105									
.									
.									
.									
Anthropology 999									
TOTAL ANTHROPOLOGY									
.									
.									
.									
Zoology 101									
Zoology 125									
.									
.									
.									
Zoology 961									
TOTAL ZOOLOGY									
TOTAL ALL COURSES									

students by department, the FTE students by departments are summed to give the FTE students for the college, and the FTE students for the colleges are summed to give the FTE students for the campus.

The illustration is for a course within a department in which LL = lower level credits; UL = upper level credits; P = professional credits; and G = graduate credits. The formula then is:

$$\frac{LL}{15} + \frac{UL}{15} + \frac{P}{15} + \frac{G}{8} = \text{FTE students}$$

Referring to Table IV, the enrollment by class, by course, was derived. The average number of credits for which the course is offered must be secured. For example, Anthropology 100 is a three credit course. If that course enrolls 125 freshmen, 75 sophomores, 50 juniors, 20 seniors, 15 special students, and 15 graduate students, there are (125 x 3) + (75 x 3) lower level credits, (50 x 3) + (20 x 3) + (15 x 3) upper level credits, and (15 x 3) graduate credits, or

$$\frac{(125x3)+(75x3)}{15} + \frac{(50x3)+(20x3)+(15x3)}{15} + \frac{(15x3)}{8} = \text{FTE students}$$

$$\frac{600}{15} + \frac{255}{15} + \frac{45}{8} = 40.0 + 17.0 + 5.6 = 62.6 \text{ FTE students.}$$

There are 40.0 lower level, 17.0 upper level, and 5.6 graduate FTE students.

Some will contend that the formula for FTE students for the above purpose should reflect a variable student credit load because of large numbers of laboratory courses in some departments, or because the per semester student load in one college to be graduated in normal progression is higher than in another college. The writers feel that this should not affect the formula. Differences rather are a function of the variable standards for teaching loads of the various departments. The teaching load standard, therefore, should reflect the differences if such differences in standards can be proven to be valid.

EXHIBIT I

METHOD OF PROJECTION BY CLASS, SEX, AND COLLEGE FOR MADISON CAMPUS OF THE UNIVERSITY OF WISCONSIN

Undergraduate Projection

At the present time, for the Madison campus of The University of Wisconsin, a simple long-range projection of undergraduate enrollments by colleges and schools on the basis of recent changes in the proportions of the total undergraduates enrolled in each college or school would be a questionable procedure due to the large proportion of students enrolled in the College of Letters and Science (66.2% in fall, 1965) and the unusually large increase in the proportion of total undergraduates enrolled in that college over the past five years. The use of this method, at this time, would result in an unrealistically high proportion of the undergraduates (80.6%) expected to be enrolled in the College of Letters and Science by the fall of 1974.

Under the assumption that the current rate of growth in the proportion of the total undergraduates enrolled in the College of Letters and Science will not continue, and that possibly a reduction in the proportion of total undergraduate enrollment in the College of Letters and Science may occur at some time during the next nine years, an alternate method of long-range projection of college and school enrollment by class and sex gives results that seem more reasonable. The alternate method uses the most recent proportions of total undergraduates by class and sex enrolled in the College of Letters and Science and applies those proportions to the institution's expected total enrollment by class and sex for the projection semester (here fall, 1974) to arrive at the expected enrollment by class and sex for the College of Letters and Science. The other colleges and schools are allotted the remaining projected students by class and sex according to their recent pattern of growth.

The general procedure for the other colleges and schools, as outlined below, was to record the five most recent fall semester enrollments for each college or school for the lower division (freshmen and sophomores) and the upper division (juniors, seniors, and specials) without any sex distinction. The average year-to-year rate of increase (or decrease) was calculated along with the average enrollment for the five years for the lower and upper divisions, respectively, for each college or school. The average rate of increase was projected to the projection semester and then it was applied to the recent five-year average enrollment in each division in each college or school. If a division within a college or school had experienced a steady uniform growth in enrollment, without any decreases, and no restrictions on enrollment could be anticipated for that college or school, the five-year average enrollment could be expected to be in the middle of the projection history period, so the average enrollment had to be projected an additional two years. Thus, "two" was added to the number of years involved in the projection before multiplying by the average rate of increase, to account for the recent growth from the average enrollment. In the case here, the projection is for nine years, so the average increase was multiplied by 11 for those divisions that have experienced a steady uniform increase in enrollment over the previous five years. For the divisions that had experienced increases and decreases in enrollment, the average five-year enrollment is the best base estimate, and the projection was only for nine years in advance; the average rates of increase (or decrease) for these divisions were multiplied by nine.

The lower and upper division projected totals for each college or school were broken down into class and sex according to the class-sex proportions for the recent five years. Each class and sex group was summed over the colleges and schools to arrive at tentative totals. Such totals might not agree with the institution's expected totals (with the projected Letters and Science students subtracted), and in fact did not. Thus each tentative college or school projection was increased or decreased by a constant proportion within each class-sex division to arrive at the expected class-sex totals for the projection semester.

The sexes were combined for the basic projection because of the erratic enrollment patterns for women in some colleges or schools (such as Engineering) and for men in others (such as Nursing). Lower and upper divisions were used instead of straight class divisions for two reasons. First, undergraduate majors generally are not determined until the junior year at The University of Wisconsin, and second, erratic fluctuation in enrollments in some colleges and schools are smoothed out by combining the two classes.

This general procedure was slightly deviated from for the College of Engineering and the School of Nursing. The average enrollment increases and the average enrollments were based on the most recent four years, rather than the most recent five years. The School of Nursing had experienced a recent rapid increase in enrollment which is not expected to continue, while the College of Engineering had experienced a decrease in enrollment which at the present time appears to be reversing. In addition, the average growth rate of enrollment in the School of Nursing was cut in half because of the anticipated restriction of enrollment in the School of Nursing.

This system gives conservative growth (or decrease) estimates in that the average increase rates are not applied to successive yearly expected enrollments, but are multiplied by the number of projection years and applied to the average base-period enrollment. The result is that sizable recent enrollment changes that are not likely to continue have less influence than if successive yearly expected enrollments were used with the increase rates.

General Procedure

1. Letters and Science

   a. Calculate the most recent proportion of total fall undergraduates enrolled in the College of Letters and Science for each class-sex division.
   b. Apply these proportions to the respective class-sex divisions of the campus projection for the projection semester. (This gives the expected Letters and Science enrollments for each class-sex division.)
   c. Subtract the expected Letters and Science enrollments from the campus projected enrollments for each class-sex division. (This gives the remaining projected students to be allotted to the other colleges and schools.)

2. Other Colleges and Schools

   a. Record the fall undergraduate enrollments for the most recent five years for each college or school according to lower division and upper division (i.e., total freshmen and sophomores--men and women--in Agriculture; total juniors, seniors, and specials--men and women--in Agriculture; total freshmen and sophomores--men and women--in Home Economics, etc.).
   b. Starting with the second recorded year, divide each year's enrollment by the previous year's enrollment for each division within each college or school. (This gives four yearly rates of increase [or decrease] for each group.)

c. Average these four yearly increases in proportion for each group and multiply these averages by the number of years to be projected. Add one to each projected increase rate to obtain the projection factors. (This merely causes the average enrollment to be included when these projected increase rates are applied to the average enrollments.)

d. Average the five-year enrollments for each division within each college or school and apply the respective projection factors (from 2c) to these averages. This gives the tentative projections for divisions within colleges and schools.

e. Calculate the five-year average class-sex proportions for the two divisions within each college or school for the five-year period. (In the lower division of Agriculture, for example, divide each of the total male freshmen, the total female freshmen, the total male sophomores, and the total female sophomores for the five years by the total freshmen and sophomores enrolled in Agriculture for the five-year period.)

f. Apply the proportions arrived at in (2e) to the tentative projection for the respective divisions within colleges and schools (step 2d). This gives the tentative class-sex projections for each college or school. (These are tentative since they have to be weighted on the basis of the class-sex pool anticipated for the campus for the projection semester.)

g. Sum each tentative class-sex projection (step 2f) through the colleges and schools to arrive at the tentative class-sex totals.

h. Divide each class-sex remainder (step 1c) by the respective tentative class-sex totals (step 2g) to arrive at the scaling factor for each class-sex division.

i. Apply the appropriate scaling factor (step 2h) to each tentative college or school projection (step 2f) within each class-sex division. These then give the class-sex projections for the non-Letters and Science colleges and schools and when added to the Letters and Science projections should agree with the campus undergraduate class-sex projection for the projection semester.

Graduate Projection

The projection of the fall 1974 graduate enrollment by sex and college for the Madison campus of The University of Wisconsin was done by a method similar to that used for the undergraduate projections for that period. Graduate student enrollment in all colleges and schools had, in general, increased during the five-year projection base period (1961-1965). Consequently, for each college or school, the average rate of increase in enrollment during the five-year period was calculated along with the average enrollment for the five years. To project the enrollment by college or school at the end of the nine-year period (fall 1974), the average rate of increase over the five-year period was multiplied by 11 and then applied to the five-year average enrollment to arrive at the tentative college or school projected enrollment. The projection factor of 11 was used instead of nine to account for the recent (two year) growth in enrollment from the five-year average enrollment figure.

The tentative projected enrollments for each college or school were summed to arrive at a tentative total. Each college or school tentative projected enrollment was increased by a constant proportion to make the total enrollment agree with the campus projected total graduate enrollment.

The sex division within each college or school projection, with the exceptions of the College of Letters and Science and the School of Pharmacy, was arrived at by using the average sex proportions during the five-year projection base period. The sex division within the College of Letters and Science was arrived at by a different process because of the steady and fairly sizable growth in the proportion of females enrolled during the five-year period. For this college, the average increase in the proportion of females for the five-year period was calculated. Due to the likeliness that the growth in the proportion of females will not continue indefinitely, the average increase in the proportion of females was divided by two and then multiplied by 11 to arrive at a projected increase in the proportion of females enrolled in the College of Letters and Science. This projected increase was added to the five-year average proportion of females and this factor was applied to the projected Letters and Science enrollment to arrive at the projected number of females enrolled in the College of Letters and Science in the fall of 1974.

The sex division for the School of Pharmacy enrollment projection was also treated in a different manner than for the other colleges and schools. There was a small but steady increase in the proportion of females in that school during the five-year base period, so the latest proportion of females (fall 1965) was used to establish the sex division rather than trying to project an increase in the proportion of females.

EXHIBIT II

The method of calculating the most recent (fall 1965) sex-degree level-major to total graduate enrollment ratio was not used in projecting the fall 1974 graduate majors by sex and degree level for the Madison campus of The University of Wisconsin, since there are a large number of majors and since for some majors the number of graduate students within a sex-degree level division is extremely small. An alternate method was used which allotted the projected college or school enrollment on the basis of the most recent (fall 1965) degree level-major history within the college or school.

The first step in the alternate method was to record the most recent history of majors according to level of degree for each college or school. Next, for each college or school, the ratio of total graduates with a given major to the respective total college or school enrollment was calculated. These ratios were used to allot the projected total graduate enrollment within the college or school to the projected graduate majors. Degree level was then determined by the proportion of masters and doctoral candidates in the most recent history previously recorded, in each college major.

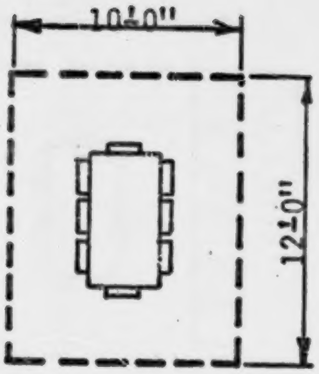
APPENDIX D

Space Module Studies

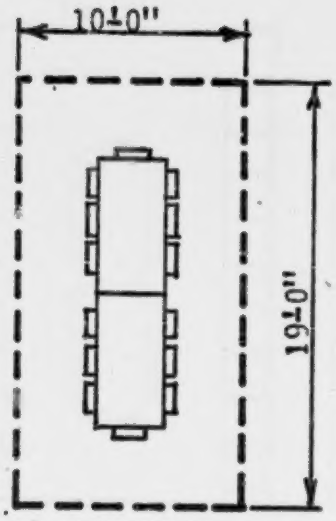
The following charts represent initial analyses of various equipment arrangements and room sizes for several Room Types. They indicate the equipment and number of station limitations imposed by different space configurations. Equipment requirements for various Room Types were made following Purdue University's inventory recommendations.

Analyses such as these are useful guides for determining space factors and getting them accepted. They also are useful validations of the space factors thus evolved.

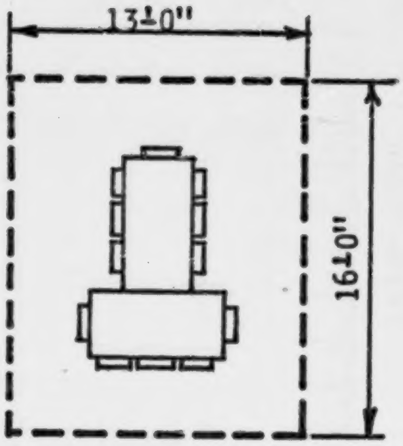
SEMINAR & CONFERENCE RMS.
3'x 6' TABLES



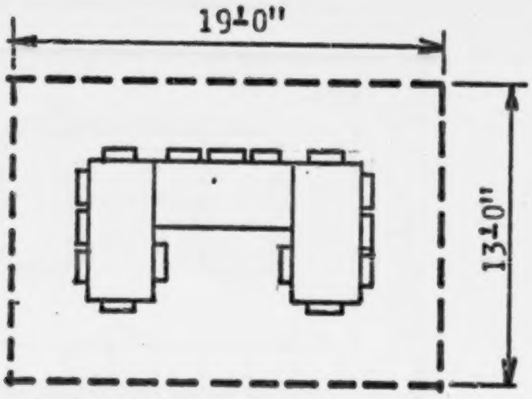
8 STATIONS
16.2 SQ.FT/STA.



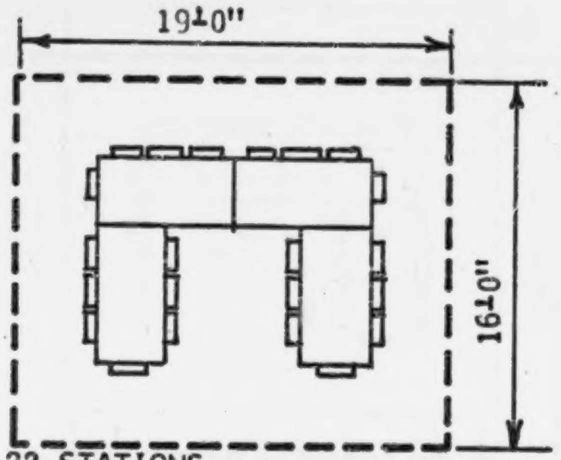
14 STATIONS
13.6 SQ.FT/STA.



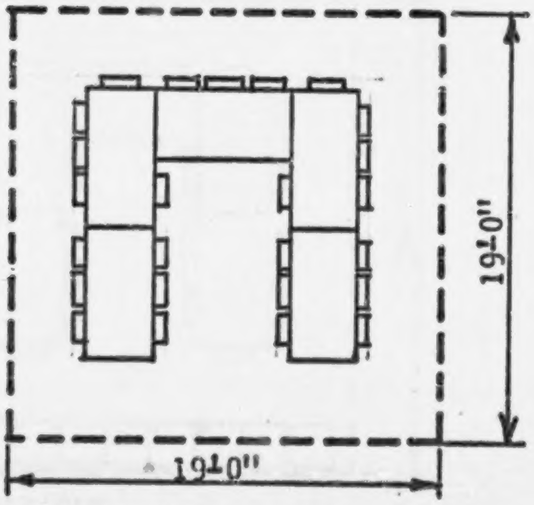
12 STATIONS
17.3 SQ.FT/STA.



15 STATIONS
16.5 SQ.FT/STA.

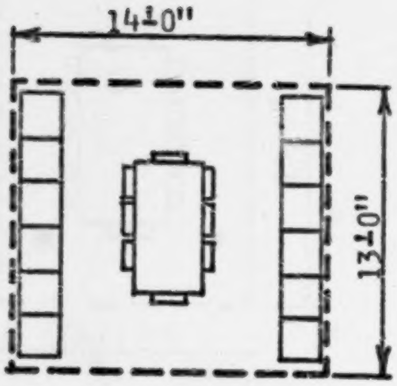


22 STATIONS
13.8 SQ.FT/STA.

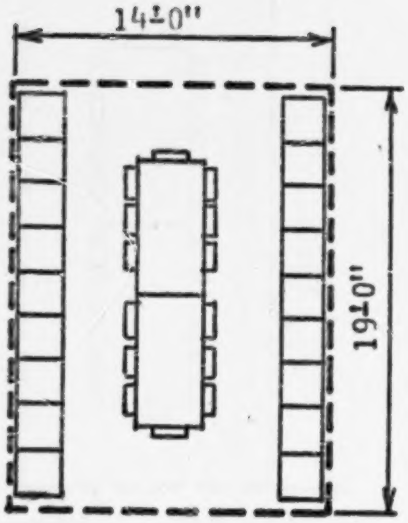


25 STATIONS
14.4 SQ.FT/STA.

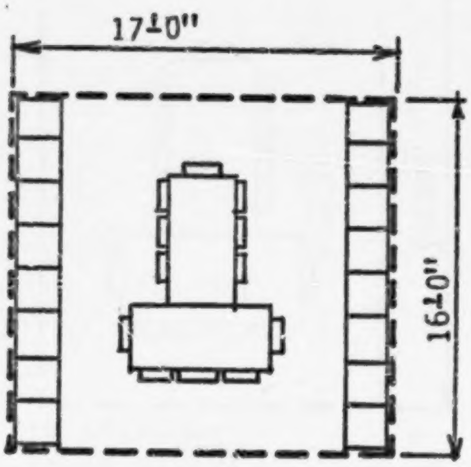
SEMINAR & CONFERENCE RMS.
3' x 6' TABLES



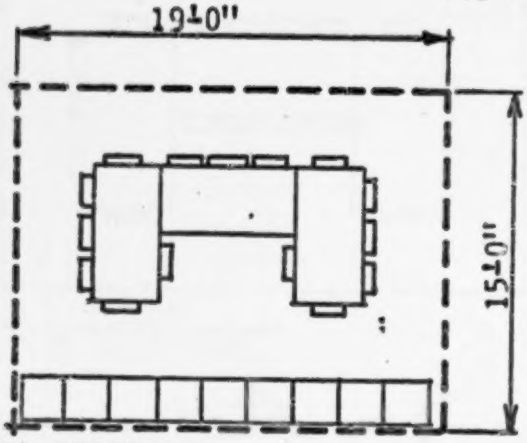
20 STATIONS
9.1 SQ.FT./ STA.



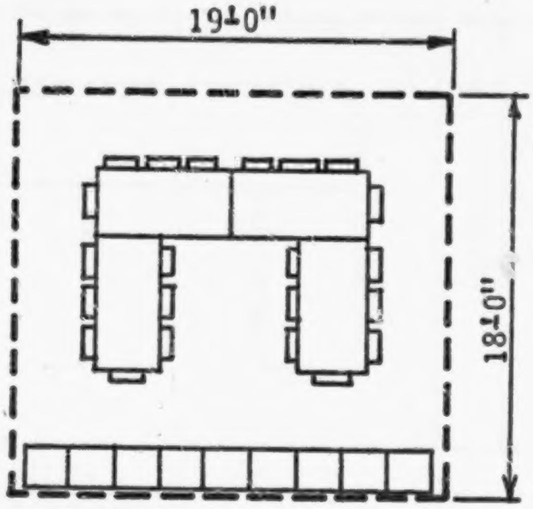
32 STATIONS
8.3 SQ.FT/STA.



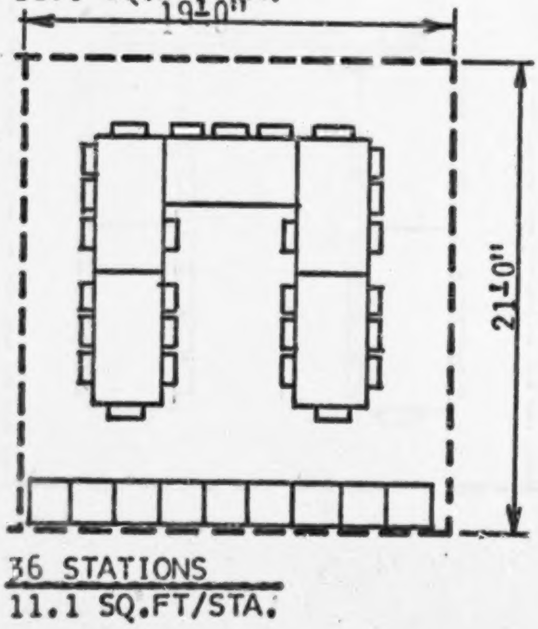
28 STATIONS
9.7 SQ.FT/STA.



24 STATIONS
11.9 SQ.FT/STA.

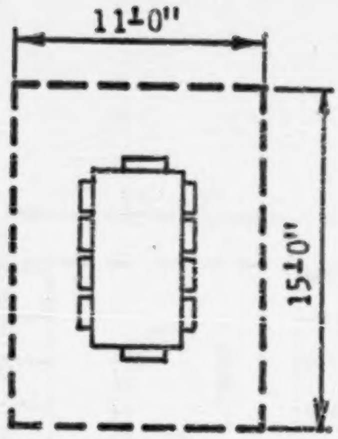


31 STATIONS
11.0 SQ.FT/STA.

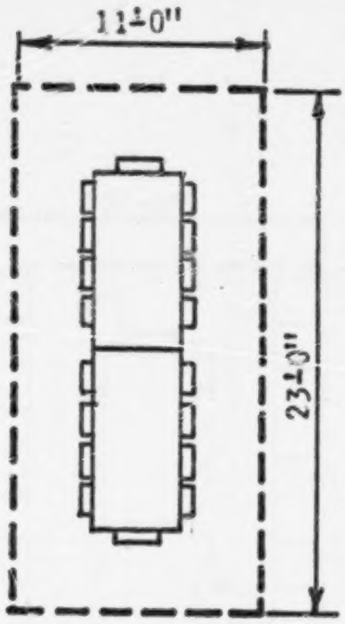


36 STATIONS
11.1 SQ.FT/STA.

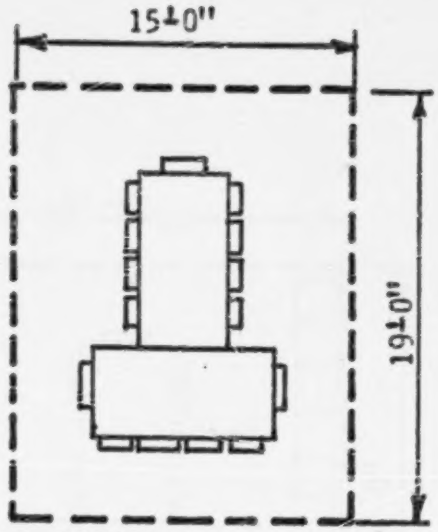
SEMINAR & CONFERENCE RMS.
4'x 8' TABLES



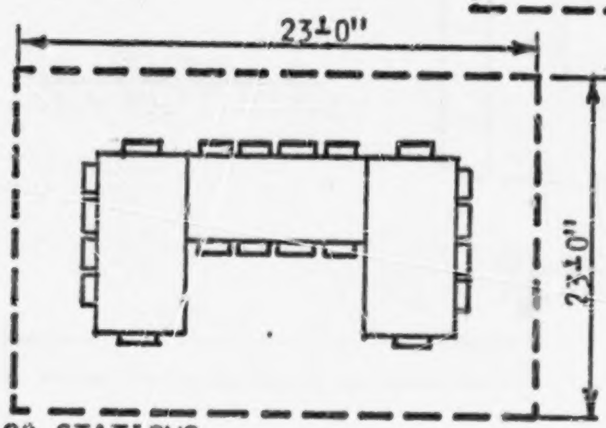
10 STATIONS
16.5 SQ.FT/STA.



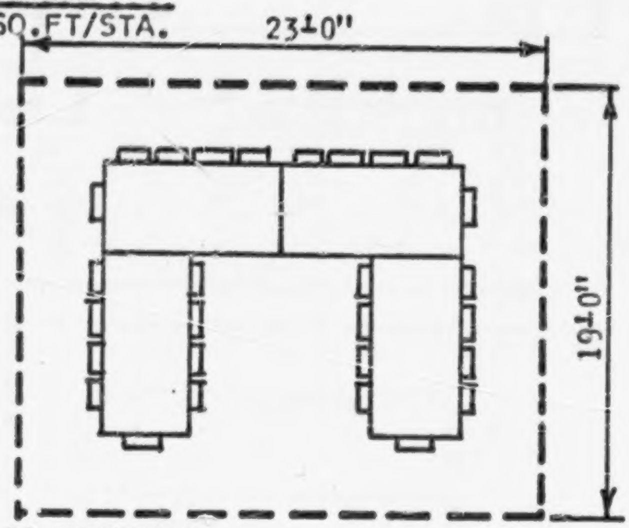
18 STATIONS
14.1 SQ.FT/STA.



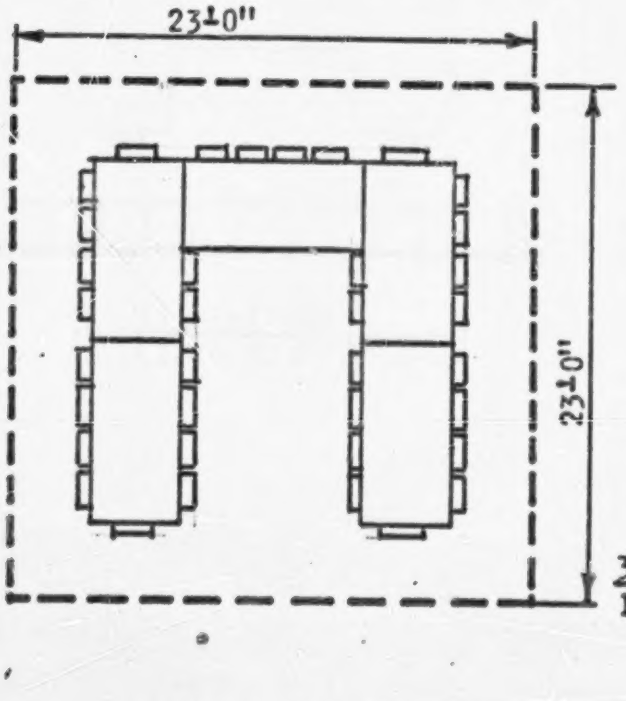
15 STATIONS
19 SQ.FT/STA.



20 STATIONS
17.25 SQ.FT/STA.

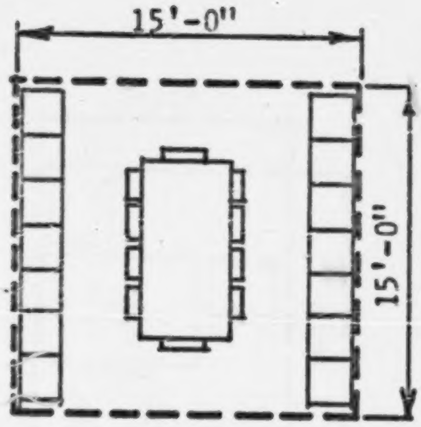


28 STATIONS
15.6 SQ.FT/STA.

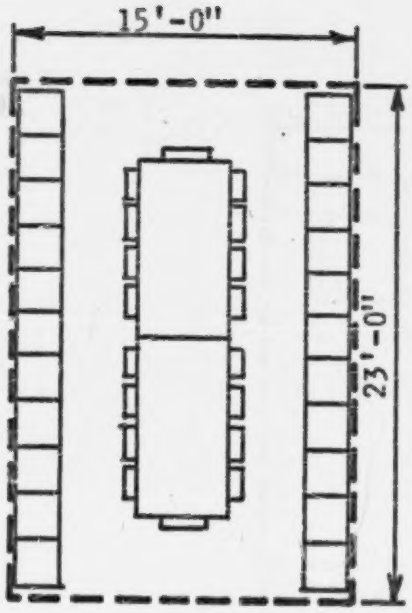


36 STATIONS
14.7 SQ.FT/STA.

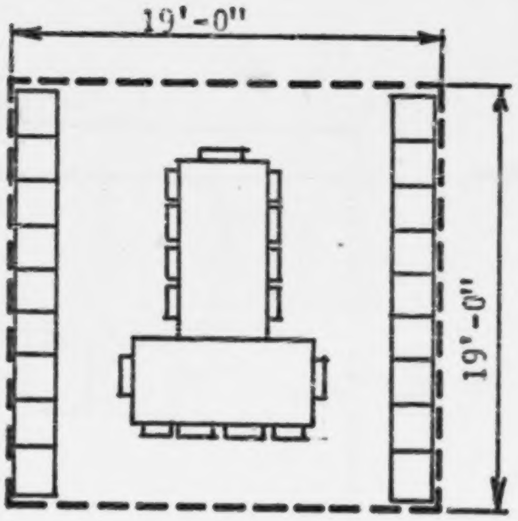
SEMINAR & CONFERENCE RMS.
4'x8' TABLES



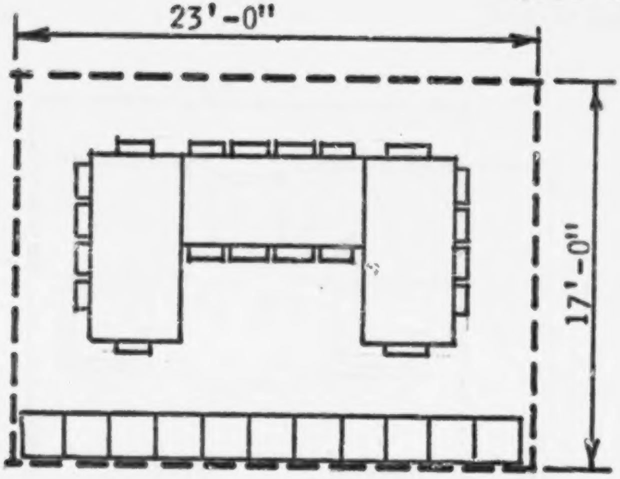
24 STATIONS
(9.4 SQ.FT./STA.)



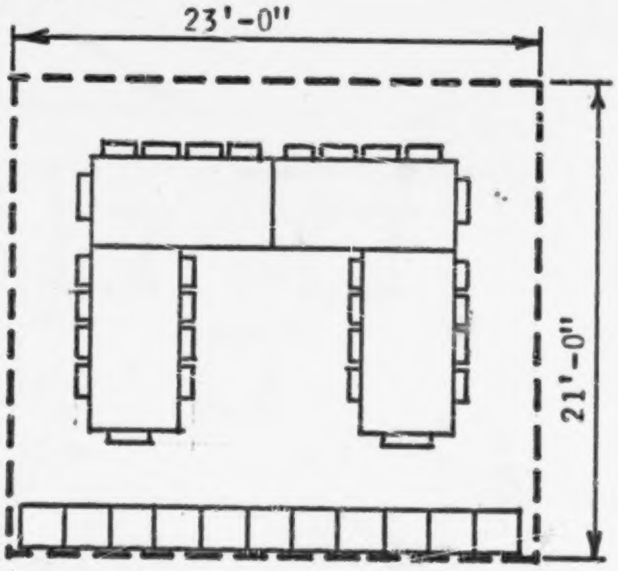
40 STATIONS
(8.6 SQ.FT./STA.)



33 STATIONS
(10.9 SQ.FT./STA)

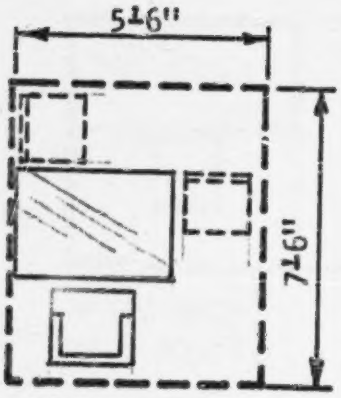


31 STATIONS
(12.6 SQ.FT./STA.)

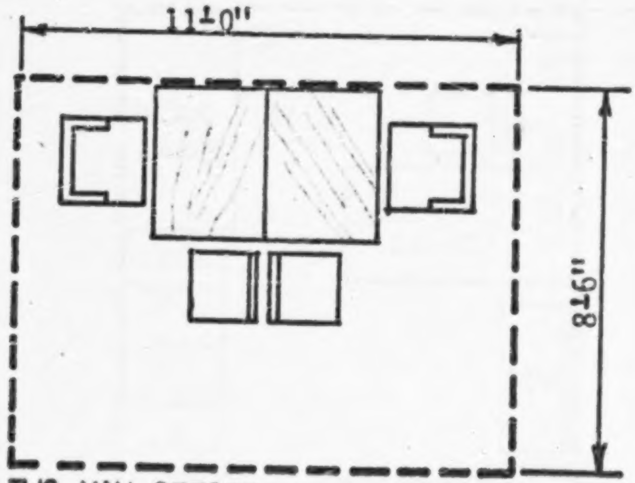


39 STATIONS
(12.4 SQ.FT./STA.)

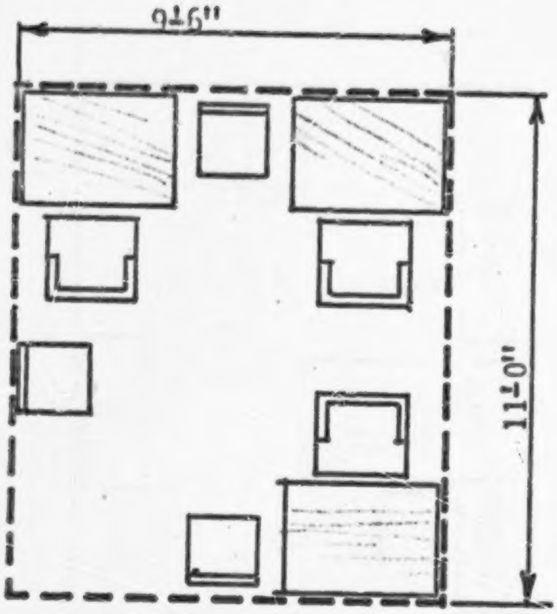
OFFICE SPACE
GRAD. STUDENTS & TEACHING ASST'S.



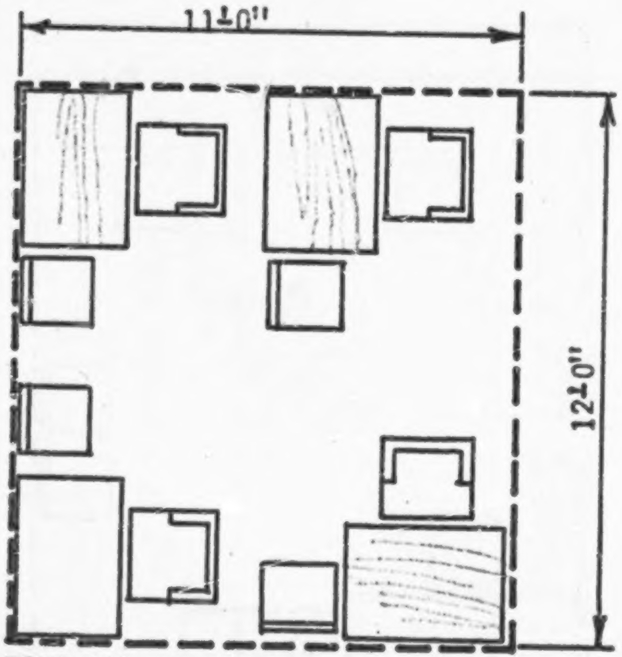
BASIC UNIT
41.25 SQ.FT.



TWO MAN OFFICE
93.5 SQ.FT. (46.7/STATION)

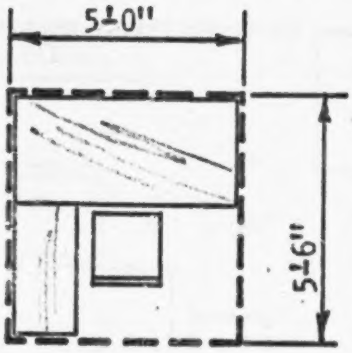


THREE MAN OFFICE
104.5 SQ.FT. (34.8/STATION)

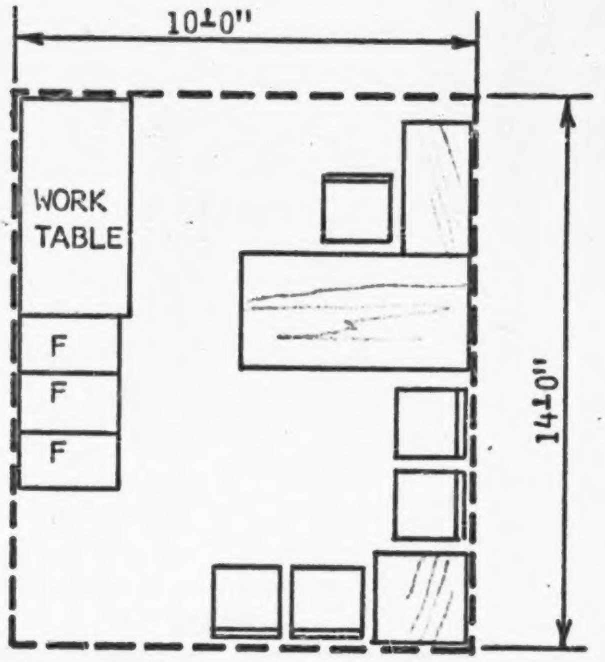


FOUR MAN OFFICE
132 SQ.FT. (33/STATION)

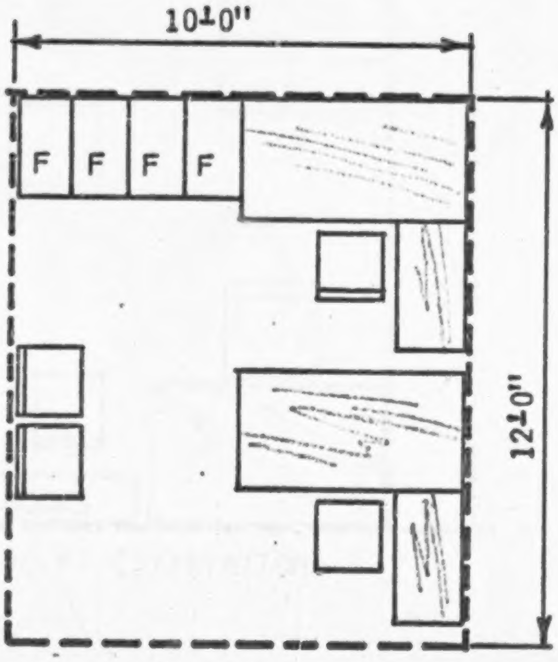
OFFICE SPACE
SECRETARIAL



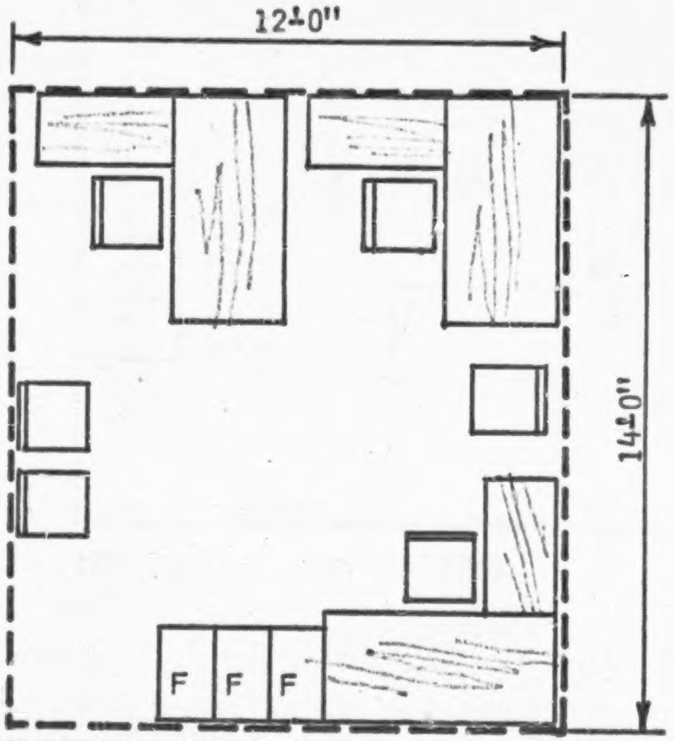
BASIC UNIT
27.5 SQ.FT.


10'-0"
WORK TABLE
F
F
F
14'-0"

ONE STATION & RECEPTION
120 SQ.FT.


10'-0"
F
F
F
F
12'-0"

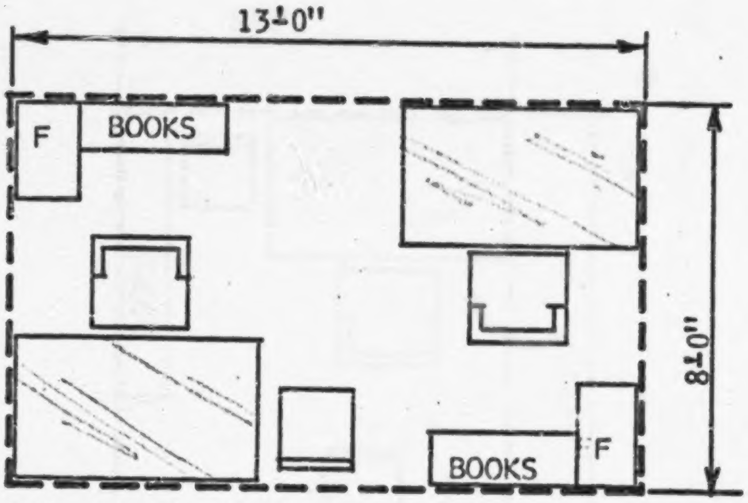
TWO STATIONS
120 SQ.FT.



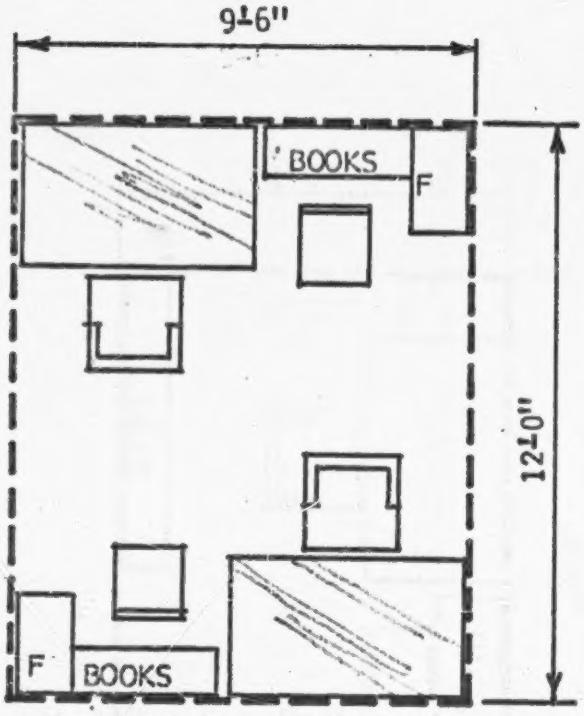
THREE STATIONS
168 SQ.FT.

OFFICE SPACE
INSTRUCTORS

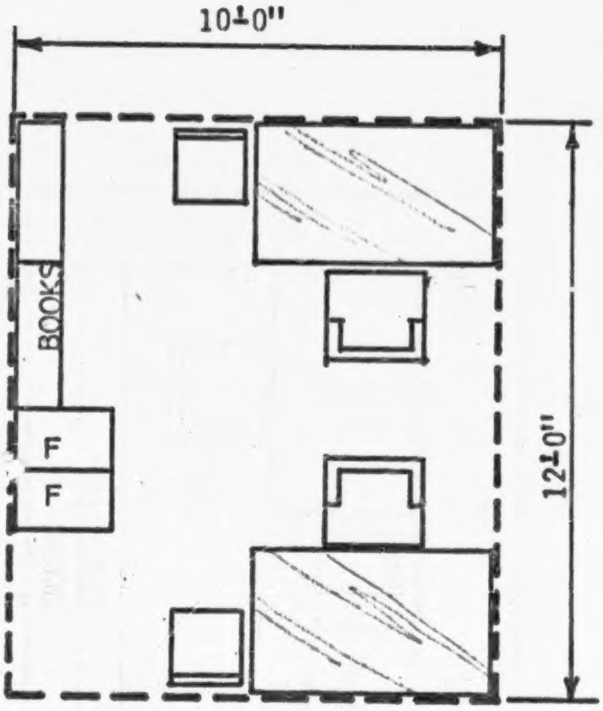
TWO-MAN OFFICES - MINIMUM EQUIPMENT


13'-0"
F
BOOKS
8'-0"
BOOKS
F

104 SQ.FT. (52/STATION)


9'-6"
BOOKS
F
12'-0"
F
BOOKS

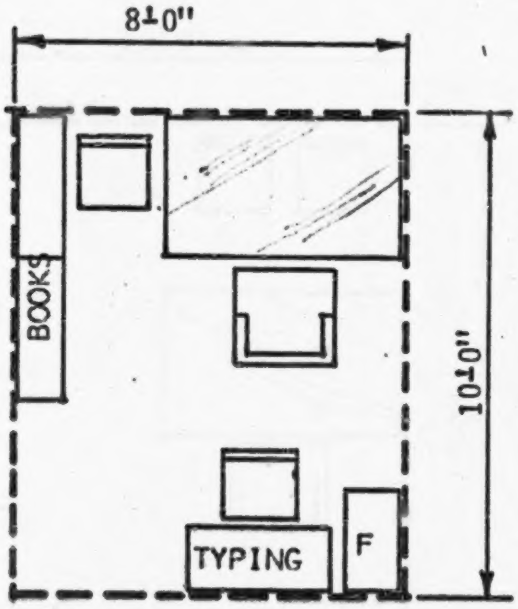
114 SQ.FT (57/STATION)


10'-0"
BOOKS
F
F
12'-0"

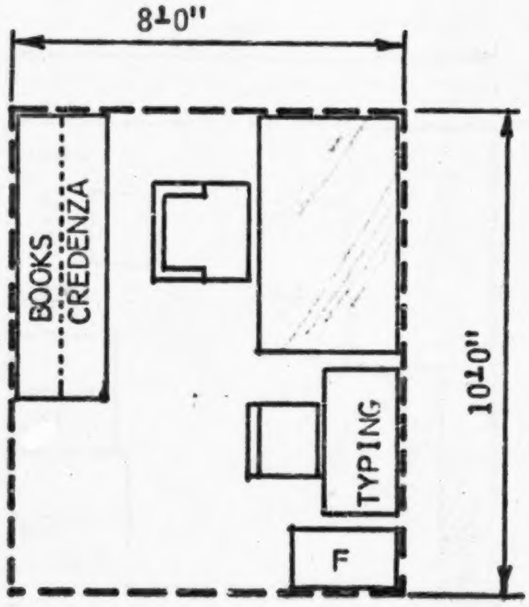
120 SQ.FT. (60/STATION)

OFFICE SPACE
PROFESSORIAL

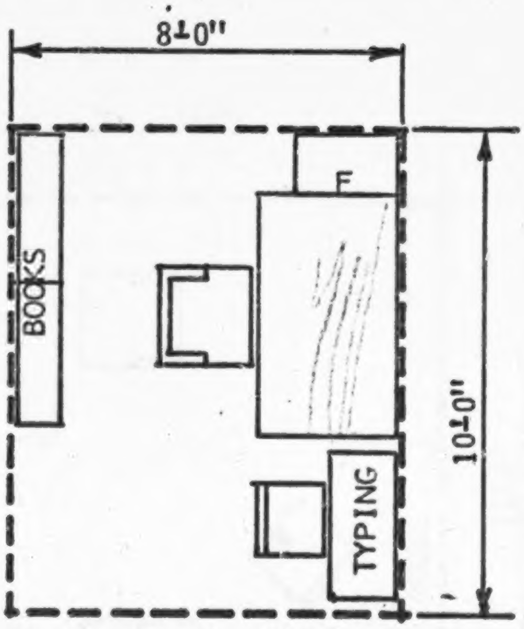
OFFICES WITH MINIMUM EQUIPMENT


8'-0"
BOOKS
TYPING
F
10'-0"

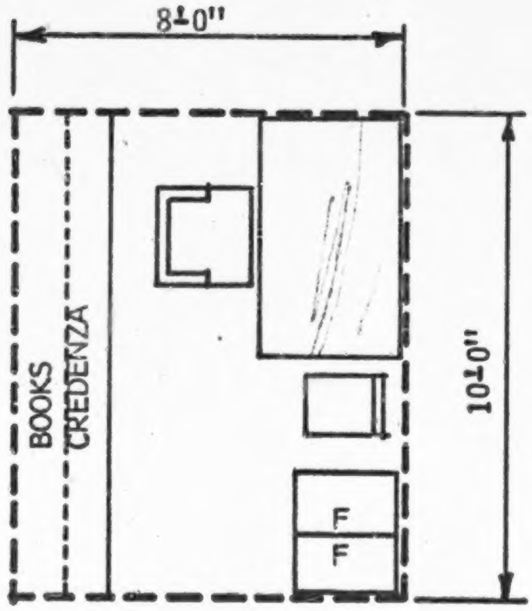
80 SQ.FT.


8'-0"
BOOKS
CREDENZA
TYPING
F
10'-0"

80 SQ.FT.


8'-0"
BOOKS
F
TYPING
10'-0"

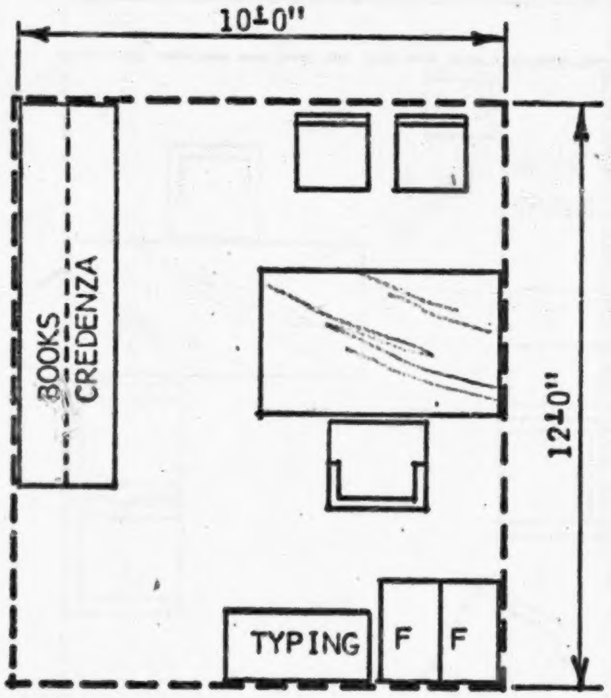
80 SQ.FT.


8'-0"
BOOKS
CREDENZA
F
F
10'-0"

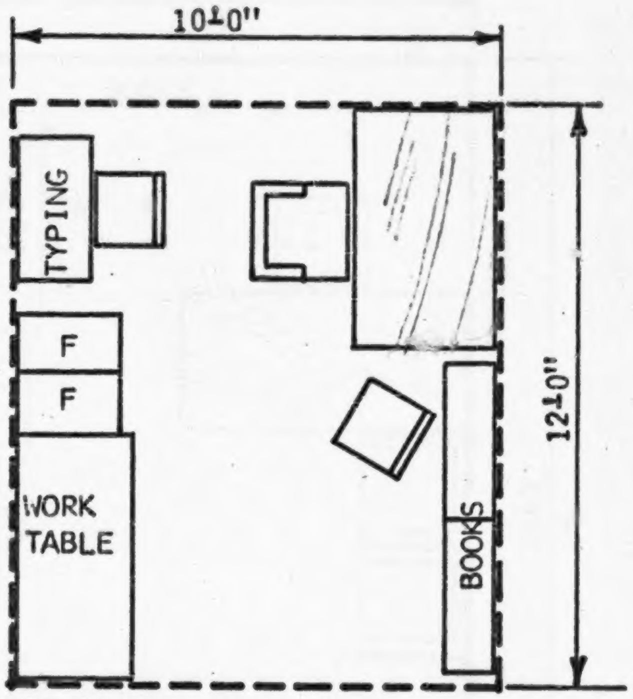
80 SQ.FT.

OFFICE SPACE
PROFESSORIAL

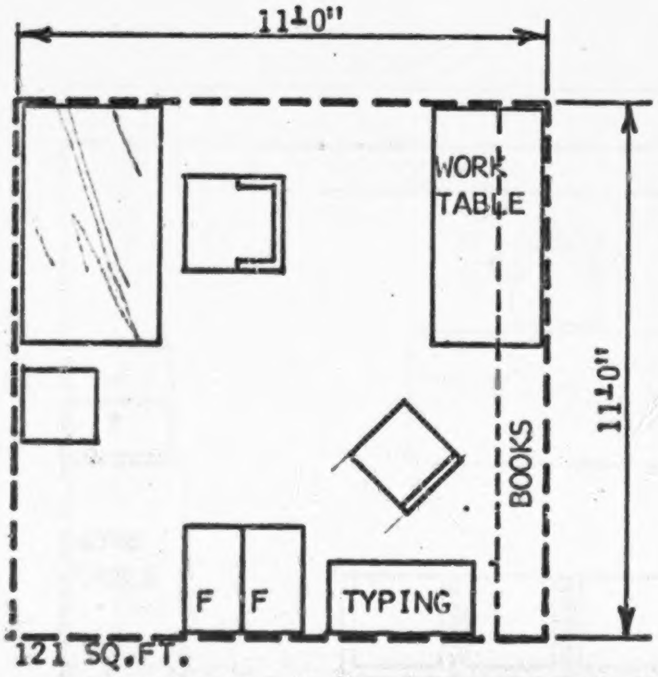
OFFICES WITH FULL EQUIPMENT


10'-0"
BOOKS
CREDENZA
12'-0"
TYPING
F
F

120 SQ.FT.

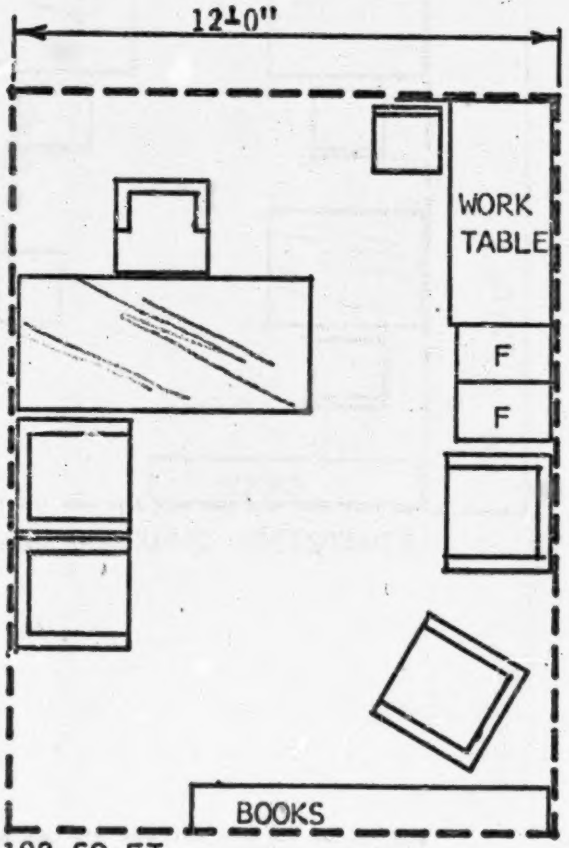

10'-0"
TYPING
F
F
WORK TABLE
BOOKS
12'-0"

120 SQ.FT.

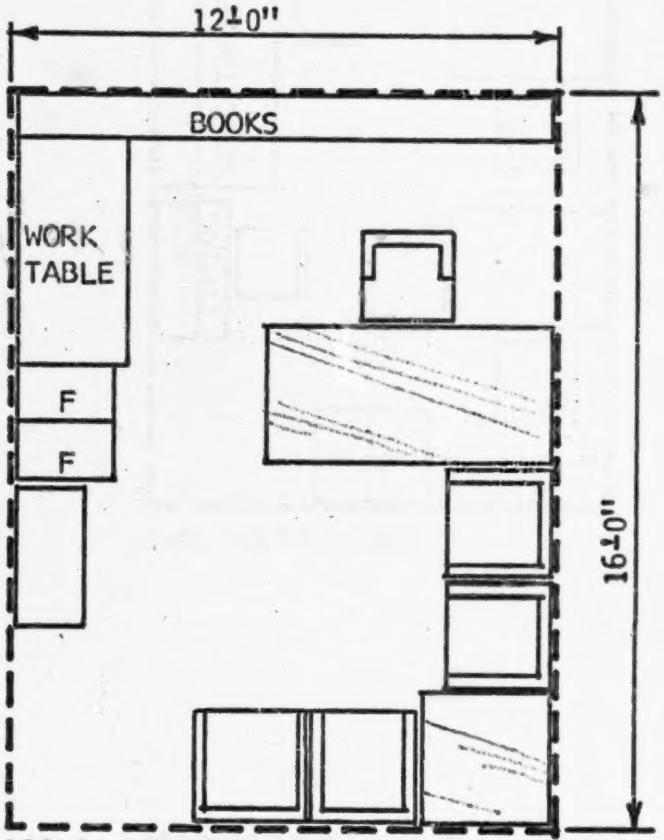

11'-0"
WORK TABLE
BOOKS
11'-0"
F
F
TYPING

121 SQ.FT.

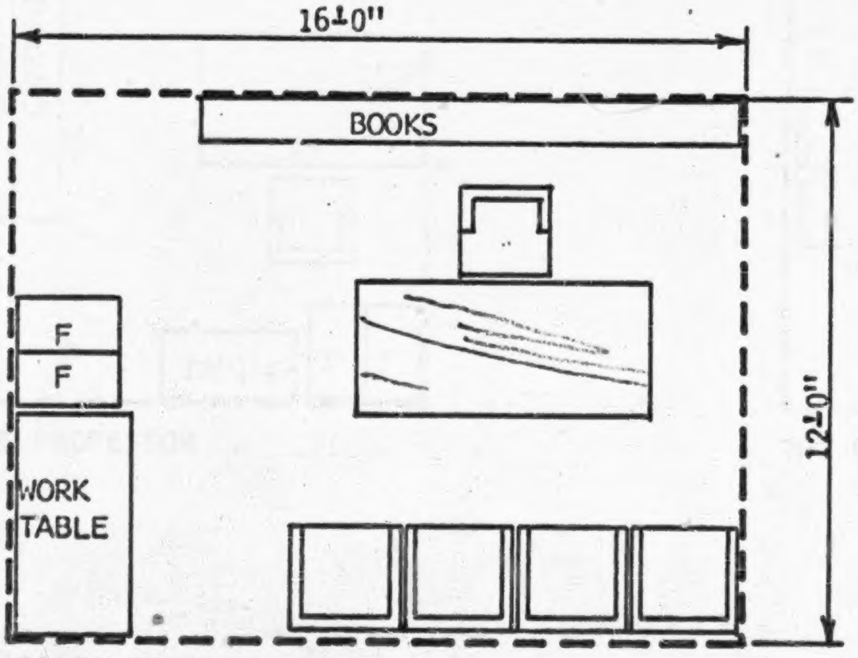
OFFICE SPACE
DEPARTMENT HEAD


12'-0"
WORK TABLE
F
F
BOOKS

192 SQ.FT.

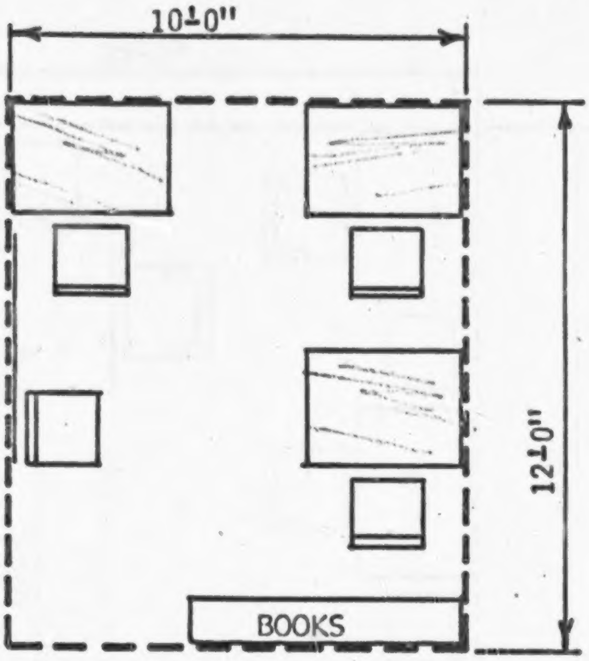

12'-0"
BOOKS
WORK TABLE
F
F
16'-0"

192 SQ.FT.

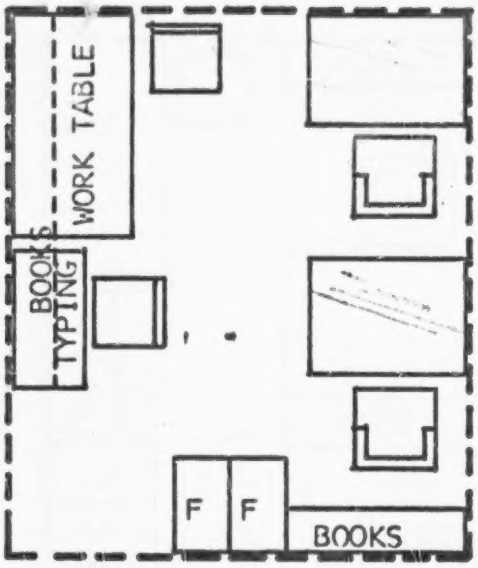

16'-0"
BOOKS
F
F
WORK TABLE
12'-0"

192 SQ.FT.

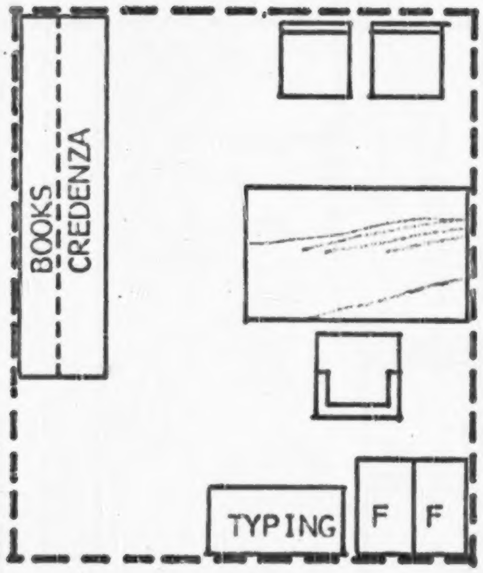
OFFICE SPACE
WHAT A 10' x 12' ROOM CAN ACCOMMODATE


10-0"
12-0"
BOOKS

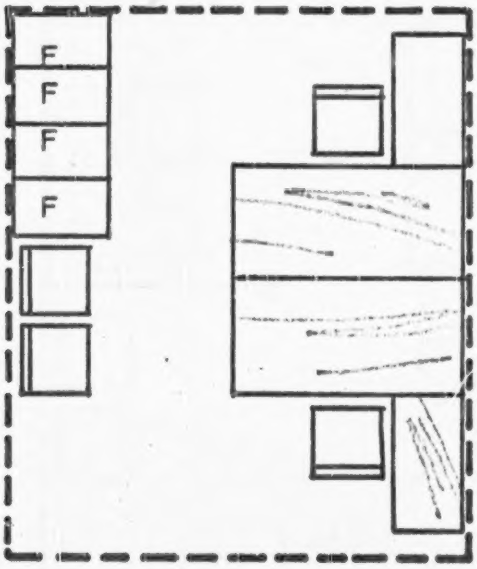
THREE GRADUATE ASSISTANTS


WORK TABLE
BOOKS
TYPING
F
F
BOOKS

TWO INSTRUCTORS

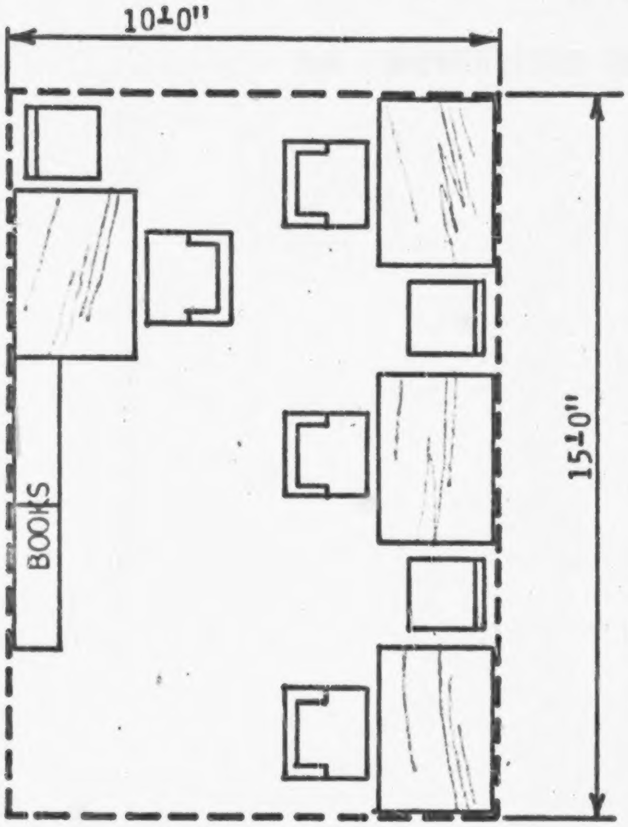

BOOKS
CREDENZA
TYPING
F
F

ONE PROFESSOR

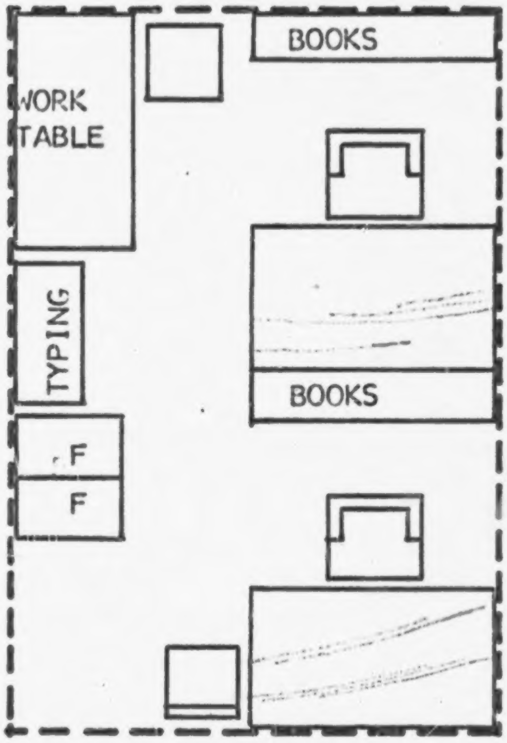


TWO SECRETARIES

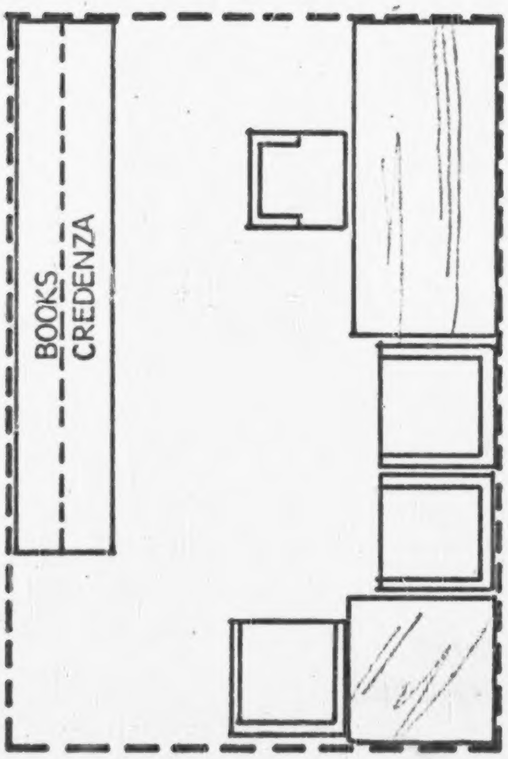
OFFICE SPACE
WHAT A 10' x 15' ROOM CAN ACCOMMODATE


10'-0"
15'-0"
BOOKS

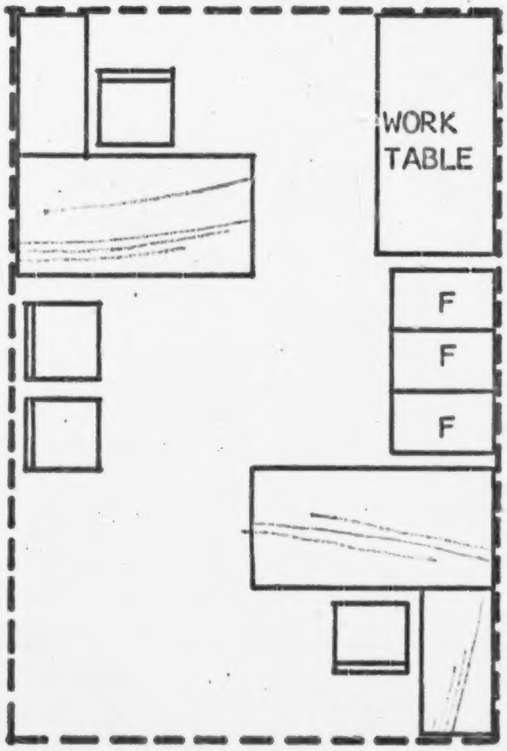
FOUR GRADUATE STUDENTS


BOOKS
WORK TABLE
TYPING
BOOKS
F
F

TWO PROFESSORS (MIN.)


BOOKS
CREDENZA

ONE DEPARTMENT HEAD (MIN.)


WORK TABLE
F
F
F

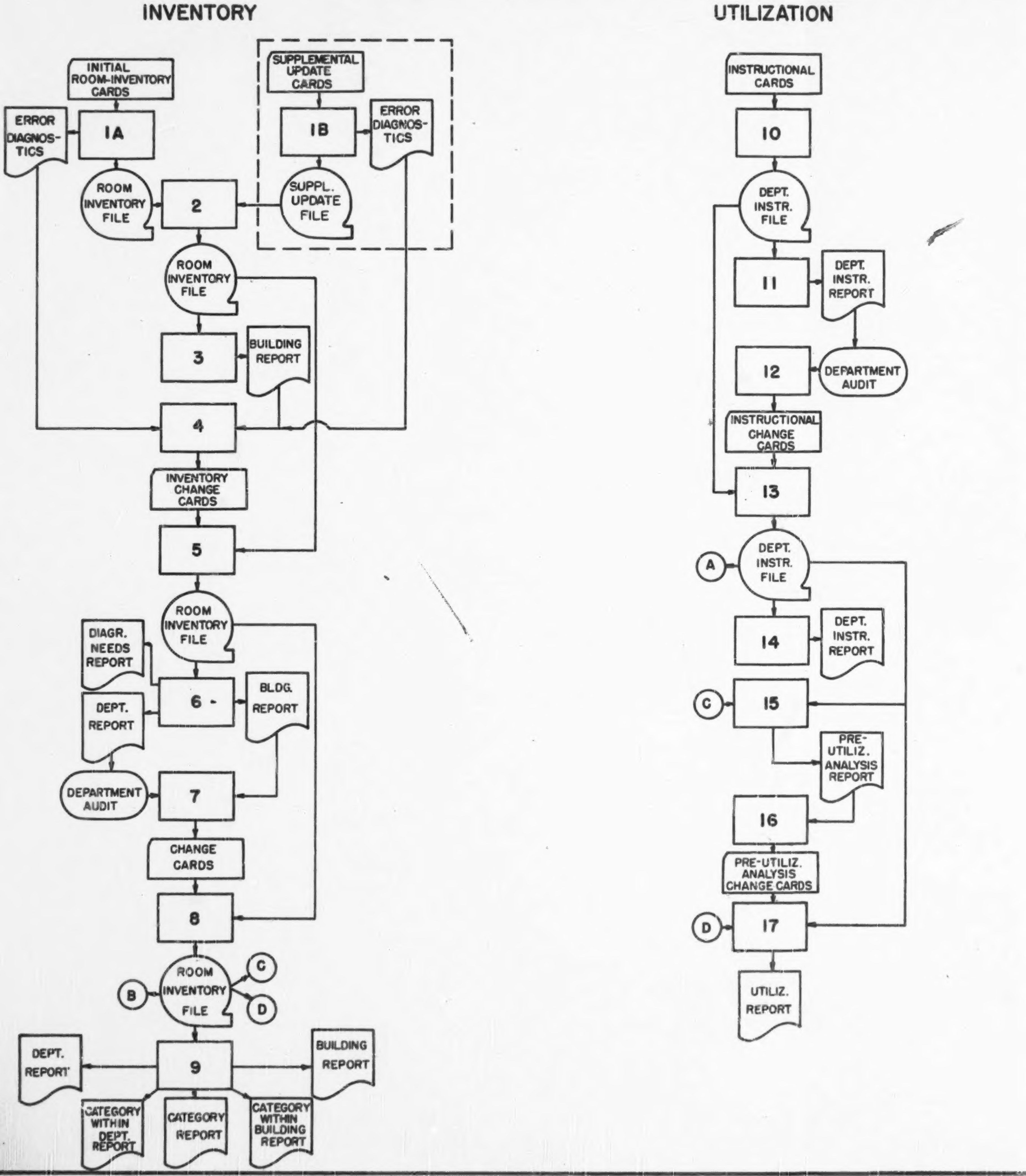
TWO SECRETARIES

APPENDIX E

THE COMPUTERIZED SPACE PROJECTION SYSTEM

FLOW CHART REPRESENTATION OF COMPUTERIZED SPACE PROJECTION SYSTEM

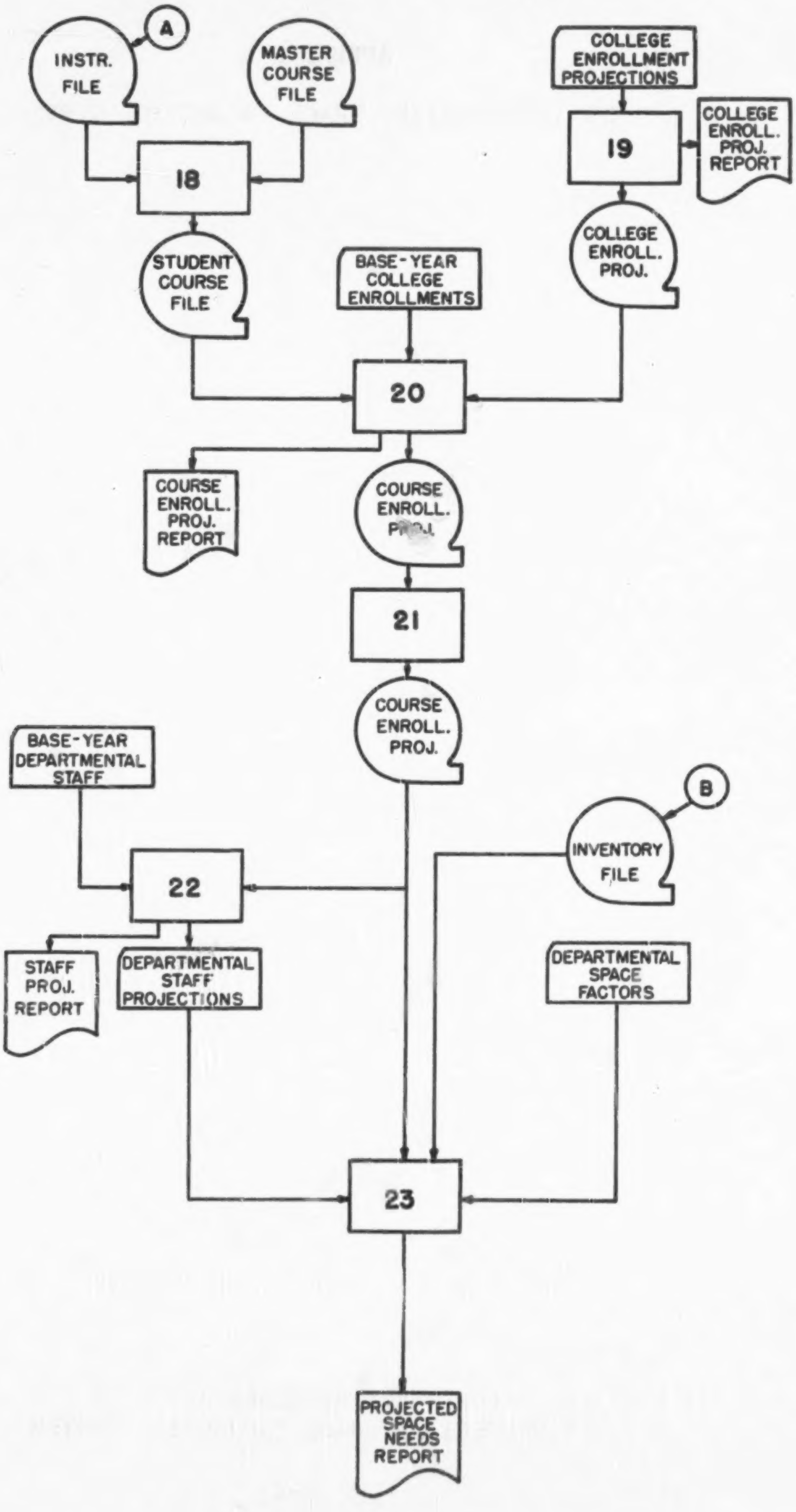
FLOW CHART REPRESENTATION OF COMPUTERIZED SPAC



INVENTORY
UTILIZATION
INITIAL ROOM-INVENTORY CARDS
ERROR DIAGNOS-TICS
1A
SUPPLEMENTAL UPDATE CARDS
1B
ERROR DIAGNOS-TICS
ROOM INVENTORY FILE
2
SUPPL. UPDATE FILE
ROOM INVENTORY FILE
3
BUILDING REPORT
4
INVENTORY CHANGE CARDS
5
ROOM INVENTORY FILE
DIAGR. NEEDS REPORT
6
BLDG. REPORT
DEPT. REPORT
DEPARTMENT AUDIT
7
CHANGE CARDS
8
ROOM INVENTORY FILE
B
C
D
9
DEPT. REPORT
BUILDING REPORT
CATEGORY WITHIN DEPT. REPORT
CATEGORY REPORT
CATEGORY WITHIN BUILDING REPORT
INSTRUCTIONAL CARDS
10
DEPT. INSTR. FILE
11
DEPT. INSTR. REPORT
12
DEPARTMENT AUDIT
INSTRUCTIONAL CHANGE CARDS
13
A
DEPT. INSTR. FILE
14
DEPT. INSTR. REPORT
C
15
PRE-UTILIZ. ANALYSIS REPORT
16
PRE-UTILIZ. ANALYSIS CHANGE CARDS
D
17
UTILIZ. REPORT

E PROJECTION SYSTEM

STAFF AND STUDENT PROJECTIONS


A
INSTR. FILE
MASTER COURSE FILE
18
STUDENT COURSE FILE
COLLEGE ENROLLMENT PROJECTIONS
19
COLLEGE ENROLL. PROJ. REPORT
COLLEGE ENROLL. PROJ.
BASE-YEAR COLLEGE ENROLLMENTS
20
COURSE ENROLL. PROJ. REPORT
COURSE ENROLL. PROJ.
21
COURSE ENROLL. PROJ.
BASE-YEAR DEPARTMENTAL STAFF
22
B
INVENTORY FILE
STAFF PROJ. REPORT
DEPARTMENTAL STAFF PROJECTIONS
DEPARTMENTAL SPACE FACTORS
23
PROJECTED SPACE NEEDS REPORT

VERBAL DESCRIPTION OF
COMPUTERIZED SPACE PROJECTION SYSTEM

E-2

VERBAL DESCRIPTION OF COMPUTERIZED SPACE PROJECTION SYSTEM

INVENTORY

1a. Computer run--required to place the initial room inventory cards as well as predetermined supplemental machine generated information on a magnetic tape file. As a by-product of this output a diagnostic listing of probable errors is created. The overall job was subdivided into 3 phases so that overlapped scheduling of remaining tasks could be expedited.

1b. Computer run--required to generate a supplemental update file and accompanying error diagnostics.

2. Computer run--required to update the existing room inventory file with the supplemental update file.

3. Computer run--after proper sequencing of the inventory file, a "space inventory by building" report is generated.

4. Manual task--required to reconcile the error diagnostic listings with the building report so as to generate the necessary deletions, changes, and additions to the inventory file in the form of punched cards.

5. Computer run--required to update the inventory file with the change cards.

6. Computer run--with proper inter-job sequencing, this run generates an updated "space inventory by department" report, and the diagrammatic needs report.

7. Manual task--required to reconcile the building report with the audited departmental report, thereby generating the necessary change cards.

8. Computer run--required to update the inventory file with the change cards.

9. Computer run--with proper inter-job sequencing, this run generates the final space reports ie., space inventory by building, department, category, category within building, and category within department.

UTILIZATION

10. Computer run--required to place instructional data on a magnetic tape file.

11. Computer run--required to generate the "departmental instructional" report for submission to individual departments.

12. Manual task--required to implement the departmental instructional updating by generating the necessary change cards.

13. Computer run--required to update the departmental instructional file with change cards.

14. Computer run--required to generate the final "departmental instructional" report.

15. Computer run--required to reconcile instructional file with inventory file and generate a pre-utilization analysis report.

16. Manual task--required to generate the change cards necessary to reconcile the instructional file with the inventory file.

17. Computer run--after proper sequencing of both the inventory and instructional files, this run generates the "utilization" report.

STAFF AND STUDENT PROJECTIONS

18. Computer run--required to generate a student course file reflective of current enrollment data necessary for "course enrollment and space" projections.

19. Computer run--required to generate the college enrollment projection report and magnetic tape file.

20. Computer run--required to project course enrollments by department. Supplemental output consists of "course enrollment projection" report and magnetic tape file inclusive of full time equivalent under-graduates and graduates by college.

21. Computer run--required for translation of academic departments to their budgetary complements for inventory compatibility.

22. Computer run--required to project departmental staff and generate a "staff projection" report and punched card file.

23. Computer run--required to generate the "projected space needs" report, including classroom, instructional laboratory, administrative office, academic office, and their respective services.